How Much Can You Save With a Small Car? PAGE 78 AUGUST . 35c Monthly First Really Portable TV How It Works How Good Is It? PAGE 64 MECHABLICE --- HANDICRAFT SECTION ---- ---

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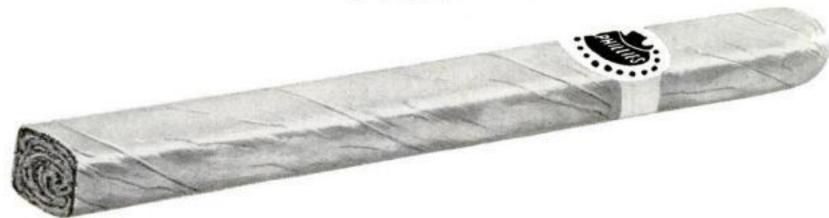


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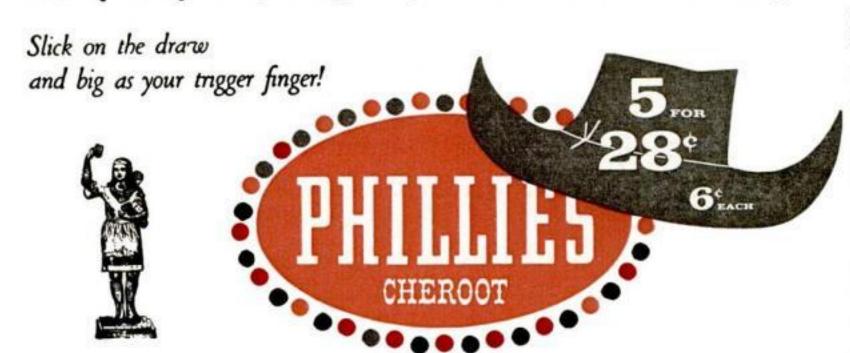
PHILLIES CHEROOTS



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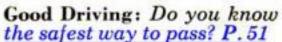
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Scout around for 28 cents and buy the handy fresh pack of 5

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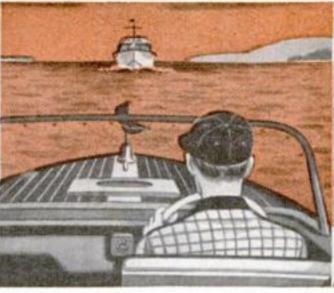
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PS Readers

TALK BACK



Lo, the Poor Pedestrian

Let's have more articles like "Stupid Traffic Rules" [April]. Maybe you could tell the pedestrian's sad story, too. In Philadelphia at 15th and Market, it takes 17 steps to cross the street—but the light changes as you take your fourth step.

P. D. Jones Jr., State College, Pa.

Car News Suits Them

As an automotive engineer, I'd like to thank you for your fine articles on automobiles. I think "Your Next Car's Electric System" [May] and the piece on transaxles some time last year [July '58] deserve special applause.

ROBERT L. WHITE, Saginaw, Mich.

... The study of automobile ignition systems back in my schooldays, when many cars were started with a hand crank, left me with a strong impression that there must be a better way to do it.

Your description and illustrations of the newest ideas indicate giant strides in that direction. Your diagrams made the ideas quite clear, even to an amateur, and I enjoyed the article thoroughly.

W. E. ADAMSON, Rochester, N. Y.

Fan Discusses Tape

I have had a tape recorder for six years, so "What's Coming in Stereo Tape" [June] was interesting to me. My tape library exceeds half a hundred volumes, and I certainly agree that tape has many advantages over the disc.

You say "tape doesn't get noisy with use" and "never wears out." This is true with the more expensive brands. One of the cheaper brands I've tried develops an irritating screech after replay a number of times. This doesn't disappear with erasing and rerecording.

Another that costs a bit more has a tendency to lose oxide from portions of the tape, thus permitting several inches to slip by the playing heads at a faster speed than the rest. The 1,800- and 2,400-foot reels tend to stretch readily, lowering tone. But my favorite brand (an 1,800-foot reel) will break before it will stretch enough to harm the recording.

JAMES SYKES, Colorado Springs, Col.

Old Mechanic Talks Back

As an old retired auto mechanic, I agree with Mr. Bezek ["PS Readers Talk Back," June] that there's a lot to be said for timing with ping.

I can well recall setting the spark ahead on old Model Ts by bending the spark advance lever—there was no other way to mechanically change the setting. Thus we could tune up an old car with just the hint of a ping. And would that old T shag the gravel from under her rear wheels! You had to be careful: If you set the spark too far in advance, you might end up with a damaged arm from kickback when cranking the motor by hand.

H. O. WHITE, Amberg, Wis.

Just Progress

That was certainly a very interesting picture on your March cover. But didn't



I see the same thing 20 years ago on your April, 1939, cover?

B. LINDENBAUM, Dayton.

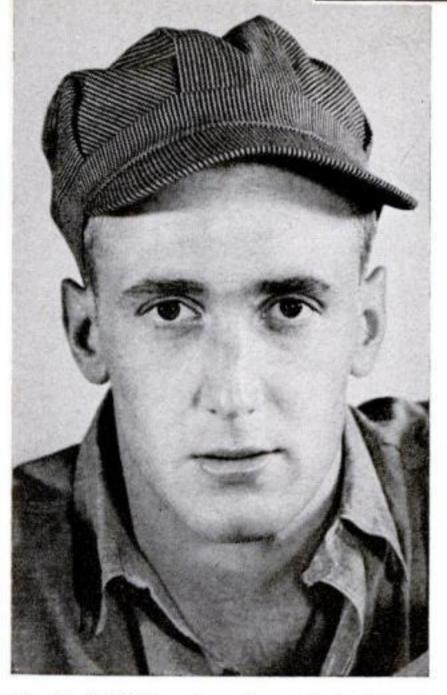
Words Fail Us

THIRTY years' experience as a do-ityourself woodworker made "Carpenter's

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CONTINUED

"Your name is on the list"



Doug Mott was not surprised. The recession was on and the assembly line where he worked was almost at a standstill.

And then, strangely, the boss began to smile. "You know how the Engineering Department sends us blueprints and then we have to send them back for revision because they just aren't practical to produce?" Doug nodded . . . wondering. "That's waste . . . and we can't allow it to continue. That's why we thought that if we had a man who knew assembly and production - and drafting, too - he could act as liaison man between engineering and production. You know production, Doug . . . and you're studying drafting with I.C.S. You've got a new job. Congratulations!"

Doug Mott now heads a drafting room. But he will never forget the day his name was on the list to be laid off.

Good times or bad, I.C.S. training sets a man off from his fellows, puts him on the road to promotion. You can start on that road by filling out the coupon now!

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City	Zone State Check box and save 45¢ delivery charge by enclosing WITH coupon entire payment of \$7.95 for Auto Repair Manual (or \$9 Truck Repair Manual.) Same return-refund privilege.

Lingo" [May] attract my eye on the first skim-through. Now then:

The swage. I know such a tool is used to spread a saw tooth, but surely the device you picture is a saw set. A swage rides on top of the tooth to shape it equally on both sides; a set bends the tooth to one side only.

Screeds. I've sold thousands of feet of screeds, but they were two-by-fours to make forms; not a float to strike off the cement. The forms were for footings of buildings in all cases.

Geography may enter into the picture. British carpenters, for instance, install screeds for plasterers' guides. In my locality, plasterers require "grounds."

F. O. SUHRING, Sarnia, Ont.

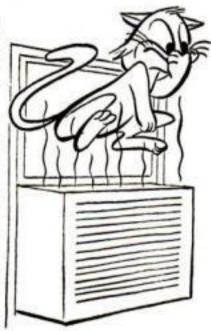
We've GOT a Lathe

You suggest drilling small holes in license-plate bolts to safety-wire them, and in pliers to make a hose-clamp tool ["Hints from the Model Garage," April]. Did you ever try to do this? These hints must be for lathe owners. They're good ideas, but not too easy for the man with a hand electric drill.

KEN GREENBERG, Chicago.

Kitty Gets a Champion

THE tip on keeping neighborhood cats off a window-sill air conditioner [May] appalled me. Instead of covering it with a tack-studded cover of screening, why not use a cat repellent? The cover would be 100 percent efficient, but might bring injury to helpless animals. I be-



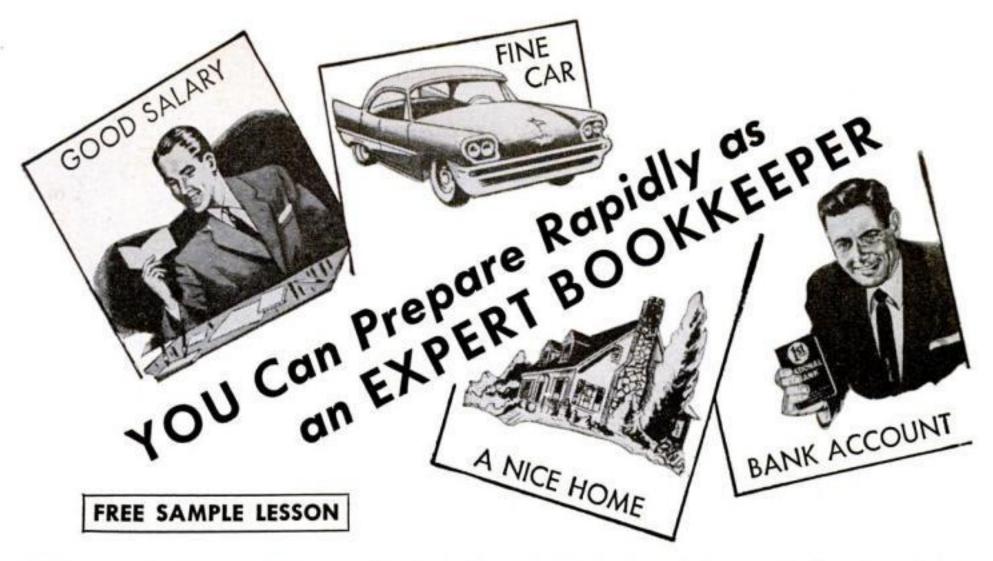
lieve any user would be guilty of extreme cruelty.

CHARLES BRENNER, Bronx, NYC.

Hood Light Worries Him

ONE of the "Hints from the Model Garage" [June] shows how to install a light that turns on when the car hood is raised. There's a serious disadvantage in wiring the parking lights to the ignition switch to provide the underhood light.

If the ignition switch is off, the ignition can still be activated simply by turning



IF that's what you want, here's something that will interest you—a short course to quickly prepare you for your start in a successful accounting career. Not a magic formula—not a get-rich-quick scheme—but something substantial, and practical.

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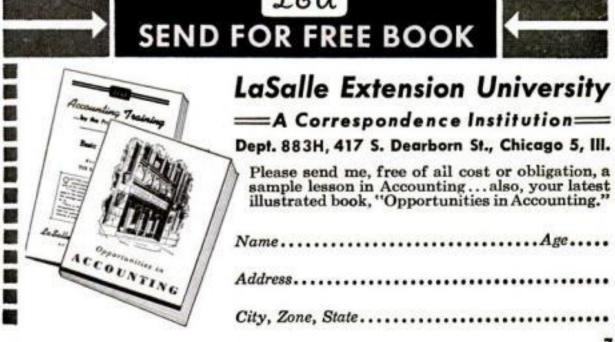
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the parking lights on (at the headlight switch) and closing the added toggle switch. The car can then be started with the starter, or by pushing.

AL ROSENCRANTZ, Toledo.

You're right, of course. Anyone who knew of the wiring could make off with the car. But car thieves generally shy away from a strange switch, fearing a theft alarm.

We Use Inversion Specs

When you run a quiz like the one on foreign cars [June], the answers are always inverted. I do not have too much trouble reading upside down, but it is a little slower and I am always in a hurry to get to the next item. I sure



would appreciate it if you'd print your whole magazine right-side-up.

F. M. VANDERVOORT, Euclid, Ohio.

Accolade for the Tucker

So the Tucker engine was "big and heavy compared to the air-cooled aluminum power plant Chevy is readying" for its rear-engine small car [June]. But you forgot to mention several things:

The Tucker engine was about four times as large in displacement, yet weighed under 500 pounds—less than the

Chevy straight six or new V-8.

Even with 589 cubic inches and automatic transmission, the Tucker averaged 20 m.p.g. at 100-m.p.h. cruising speed—as good as Chevrolet's new opposed-six.

And what's "new" about it? Tucker had everything it has and had it 10 years ago—including fuel injection that hasn't been matched yet by Detroit's gasoline engines. But I'm glad Detroit is finally putting the engine in the rear.

Fred Fetner Jr., Columbia, S. C.

He Says It's Knot So

I'd like to clear up a little misunderstanding on knots ["Navy's New Hitand-Run Undersea Raider," June]:

You say the submarine travels at five or six knots an hour. The knot is a unit



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FREE - whether you keep the Course or not - THREE amazing DETECT-O-SCOPE Charts. TV and RADIO Scopes enable you to spot all tube troubles in a jiffy. CIRCUIT Scope spots all circuit troubles. Make fix-it jobs easier, faster. 16 x 21 inches. ALL THREE (worth \$3.00) yours FREE while they last on this introductory offer.



AUTO MECHANICS

A better job with more pay will mean better living for you. It can mean a fine home, a new car, nice vacations, and good educations for the kids. If you would like to earn up to \$125 a week and more—and be able to afford better living, train yourself in Auto Mechanics. You can do it with CTI showing you how—and you can learn at home in spare time!

GOOD JOBS ARE WAITING EVERYWHERE because there are over 60 million cars and trucks on the road—7 million new ones each year. One-third are in the heavy-repair classification. Skilled mechanics are needed to keep these cars operating. You can be one of them—make big money, enjoy lifetime security—even open a shop!

EARN AS YOU LEARN just as many CTI students do. They make up to \$15 a week and more in spare time. Some start their own shops by graduation time. CTI Shop-Method Home training, based on resident school practice, makes every step easy.

DIESEL MECHANICS OR BODY-FENDER TRAINING is also yours at no extra cost. A wonderful chance to give yourself a well-rounded education. Only CTI gives you this extra choice! Get the facts: Mail coupon.



YOU PRACTICE WITH THIS TUNE-UP KIT

Kit includes a Compression Tester, a Vacuum Gauge and Fuel Pump Tester, an Ignition Timing Light, and a portable steel case. These professional instruments help you locate engine troubles, let you get useful practice. You keep this kit!

MECHANIC'S TOOLS TOO

You'll use these tools to get real experience. They'll increase your interest, stamp you as a "pro." You'll earn spare time cash with them. No extra cost for tools—you keep them.



MAIL COUPON TODAY!

MAIL TODAY FOR 2 FREE BOOKS

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Send your new Auto Mechanics book and Sample Lesson. BOTH FREE.	South Michael
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of speed—one nautical mile an hour—so the article should have read simply "five or six knots." Knots-per-hour is a unit of acceleration, not speed.

H. W. Schwartz, Paxton, Ill.

If You're Reupholstering . . .

Yoicks! I just read reupholstering [June] after I had rewebbed two chair seats. Two suggestions for you:

1. The more webbing, the stronger the job. Your photo on attaching webbing

shows three strips used, but there is easily

room for four strips.

2. Always place the back of the webbing stretcher against the chair with the teeth in the webbing. Then in straightening out the stretcher to form a plane with the top of the chair frame, the webbing gets the proper tension without damage to the chair frame.

ABE BRAYER, NYC.

Fooling the Radar Cops

You say decking a car with fluorescent lights plays hob with radar ["Why You Can't Fool the Radar Cops," May]. Then why couldn't trucks use such lights to display the firm name on the sides of the vans? It would be inexpensive since AC generators could be operated from the fan belt.

C. A. Strait, Sebastopol, Cal.

This would work, no doubt. But the lights would also advertise that here is a driver who disregards speed laws.

... To foul up radar, connect a radio antenna to one spark plug. The spark—electronic noise covering all frequencies—will be broadcast from the antenna. When frequencies other than that broadcast by the radar are picked up by it, your car will appear to be traveling at all speeds, including reverse.

You can make a radar detector from a neon glow lamp, some insulated wire and a dry cell of just enough voltage to not trigger the lamp. When the car enters the beam, voltage induced in the wire leads will cause the lamp to glow.

RANDALL ESTES, Piedmont, Ala.

VALUES TO \$5.00—now yours for only 99c each! Any 3 for \$2.75. Any 6 for \$4.99. We are forced to dispose of present stock at sacrifice to raise cash for new imports from Europe! All new, first quality marchandise. Satisfaction

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VALUES TO \$5.00! CTOSCOPES



glasses. Get magni-fied views at movies, theatre, sports events. Read "fine print" documents easier. Optical lenses. Light. One size fits all.

8-Piece Combination WRENCH SET



No. 701. 8 drop forged chrome-plated wrenches in kit. One side box-end, sizes 7/32"—7/16"; other side open-end, sizes 1-3/64" to 3/8". Car or house

Fix, Mend, Repair!

Stop Leaks Fast!

BONDPRUF

6 Steak Knives from W. Germany

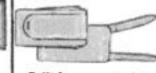


No. 89 SIX for 99c. New, first quality.
Stainless steel. Serrated
edges. Gold & Ivory hue
handles. Imported from
Solingen, W. Germany.
One million already sold. Now 50% off.

See Where It Is In Dark with Nite-Lites



No. 734, 72 for 99c! Don't grope in dark. Avoid accidents! Nite-Lites stick to any surface, glow in dark. Stick 'em on Avoid phone, bed, chairs, bath door, cellar steps, low overhead, etc. Nite-Lites recharge themselves dur-ing day. Big roll of 72. Stainless Steel MONEY CLIP



Built-In Stainless Pocket Knife Steel

No. 605. Grips cur-rency tightly. High metallic pitch alerts you accidentally dropped. Has built-in pocket knife with two blades. Stainless steel thru-out. Save 66%!

VALUES TO \$5.00!

Pocket Microscope from W. Germany

No. 12. Metal design Examine jew-eiry, watches,

smears, textiles, tissue, etc. Fits pocket. Made by famed W. German optical plant. 2 slides FREE. Thousands orig. sold for \$1.98. Save!

 \mathbf{u}_{T}

Electric Magnifier Lights Up As It Magnifies!

No. 610. Magnifies 5 times larger Brilliant light illuminates ob-ject viewed. Examine stamps, coins, currency. coins, currency, signatures, pho-tos, gems; read fine print. Uses flashlite battery. Fits pocket Orig. \$1.25

2 for 99c

Used by plumb-ers, handymen, etc. to stop leaks, fast. Mends rubber, metal, wood, glass, crockery, etc. Not affected by temperature changes. Use on boats!

No. 87. Orig. \$1 a tube. Now 2 for 99c.

BLACK EAGLE



No. 78. Orig. \$3.98 -now 99c. 38mm, unbreakable lenses. Full-size. Synchronized center focus. Free straps & lens cloth. Imported from W, Germany.

New Wallet has 40 Compartments!



vinyl wallet h a s 4 0 double-sided clear plastic c o m p a r t-ments that hold 80 photos, passes, licenses, etc. in water-proof, dust-proof safety. Snaplock. \$1.98 value.

8-Pc. Toilet Kit with ZIPPERED Case!

NEW LOW PRICE



No. 567. Simulated leather case fits pocket—has 3-sided zipper opening. Comes with mirror, comb, nail file, clipper, toothbrush, brush haider same container, holder, soap container, tonic bottle & jar for blades. Take on trips. Not \$2.98

GIANT PLASTIC TARPAULIN



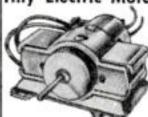
No. 4. 108 sq. feet. Not to be confused with thinner gauge cloths. Use to cover boats, hunt-ing gear; as drop cloth; for auto seat covers, etc. Wipes clean with damp cloth. Millions sold!

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☐ N a. 139 problems in multiplication, division, proportion, etc. in seconds, WITHOUT pencil & paper! pencil & paper; Same type used by big-pay engineers. 10 inches long. Does everything \$3.98 models do. Free math book included.

Tiny Electric Motor



Me. 103. Fits palm of hand—gives giant performance. Speeds to 3,600RPM's. Operates on small battery. Drives small jig saws, displays, etc. Thousands sold at \$1.98—now HALF PRICE!

CORK KNIFE



No. 125. Stainless steel. Can't sink -has cork handie. Double-edge, One side razorsharp for slicing; other side ser-rated for scraping fish. Like two knives in one. Sheath included. \$2.00 value—now less than HALF PRICE

Famous Windproof Lights in Stiff Wind!



Mo. 105. Hardened STEEL parts. Large fluid reserve. One filling— hundreds of lights. Never fails — even in stiff wind! Favorite a m o n g sportsmen.

Thousands sold at higher price. \$3.98 value.

COMBO-MATIC! 8 Instruments



Me_ 93. Imported from W. Germany. Imported Pocket binoculars, magnetic compass, magnifier, reading glass, telescope, laryngoscope, stereoscope & sun dial watch—all in one. Snaps open, folds shut. Orig. \$1.98.

50 Hollow Ground Charles Blades for 99cl

First-Fit All

d 0. 1311. Sharp hollow ground double-edged blades. Why set only 20 for 98c? We give

you 50! Guaranteed to give

close, keen shaves or money back. Millions sold!

6 Ball Point Pens Yours for Only 99c! Leakproof! Smearproof!



BLACK FOREST HUNTING KNIFE

10 INCHES

No. 76. World's most popular hunting knife. Orig. model sold for \$3.98. Our replica only 99c. Sheath FREE. Nearly 10 inches long. Use on fishing & hunting trips.



Fit All Makes!

No. 1331. 12 Re-fills for 99c. Guaranteed to fit Paper-Mate, Scripto, other type ball point pens. Sold in lots of twelve only. Blueink only.

Thoresen Holesaw Saws Any Shaped Hole for Your ¼" Electric Drill

No. 42. Insert this whole saw into 1/4" drill. Bore thru wood, plastic, etc. in widening circles. You saw any shaped hole with full saw stroke. Cut triangles, zigzags, etc. in seconds. Not \$1.25 to \$1.39.



4-Pc. Center or Power Bit Set!



No. 702. 4 pc. Bit set only 99c. Contains one each size %". 1/2". %" and 1 inch. In handy plastic kit. Fully pol-ished 14"

round shanks, standard length, drop forged steel, heat treated.

5-Pc. Goggle Kit Cost U.S. Gov't About \$5



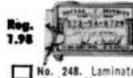
Mo. 329. Four pair of goggles, 2 dark & 2 clear with adjustable head straps. New, never used. Cost gov't about \$5—yours for 99c. Use for spraying, drilling, sports car driving, boat-ing, cycling, sun bathing, etc.

24 First Quality Camel Hair Brushes!



No. 2330. 24 Camel Hair Brushes for 99c. For hun-dreds of little touch-up jobs that big brushes can't do properly — cleaning rifle, machines, pistols, optics, etc. Sizes range from No. 1 to No. 5.

Seal Valuable Papers 9-in-1 Knife in Clear Plastic in et One Minutel



No. 248. Laminate photos, licenses, clippings, papers, etc. in clear plastic with simple finger-tip pressure. Per-manent or removable seal. Giant kit includes 12 4"x4" sheets plus bonus of 6 5"x7" sheets & easy directions. Not \$1.98.



opener, corkscrew, scissors, jackknife, awl, screwdriver. Fits pocket —opens to 5 inches. Orig. \$1.98-now half-price.

7-Pc. Korium Steel Pocket, Tool Shop!



No.243. Adjustable wrench, awl & punch, screw driver, philips screwdriver, drill, flat file. Fits pocket. Ideal for repairs of radio, TV, watches, clocks, etc. List \$3.98—yours for 99c!

12 Real Dolls!



No. 906. Make any little girl feel like a princess with these 12 real dolls. Made of life-like plastic. Movable arms & legs; dressed in differcostumes. Closeout bargain.

5-Pc. Multi-Color Deluxe Desk Set!





Check Items desired right on this page. Any item 99c. Any 3 for \$2.75. Any 6 for \$4.99. Print name & address in white space below. Tear out entire page & mail with payment. Add 11c to defray postage & insurance. Sorry, no COD's. Satisfaction guaranteed or money refunded.

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"Doing spare time re-pairs on Radio and TV. Going into full time servicing soon." Clyde Hig-gins, Waltham, Mass.

"I had a successful Radio repair shop. Now I'm Engineer for WHPE."
V. W. Workman, High Point, N. C.



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National Radio Institute

Please send me Sample Lesson of your Radio-TV Electronic Training and Catalog FREE. (No salesman will call.)

Name_____Age___

City____Zone__State____ **Accredited Member National Home Study Council**

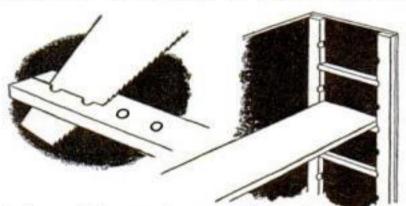
Job and Career Opportunities RADIO-TV TECHNICIAN

The ABCs of SERVICING

Tip on Shelf Building

You certainly gave us "The Fine Points of Shelf Building," [May]. But I can add a tip on building adjustable shelves:

Drill holes 2" apart, down the center of narrow stock. Then cut through the center of the holes to make two long



strips with evenly matched slots. Apply two strips to each side wall and slip adjusting bars into the slots to hold the shelves. This is so much simpler than dadoing that even a woman can do it.

MRS. I. B. LOVELACE, Santa Barbara.

Some Inches Strayed In

May I add to the confusion in the minds of readers pondering on the height of Titan, the elephant [June, p. 112]:

By your yardstick, he measures 13 feet 12 inches. In India, they'd have cut down his size to 12 feet 24 inches through sheer jealousy. On the other hand, his habitat being Africa, the Africans would certainly stretch a point and claim that he towered 14 feet high.

J. P. Urfer, Bethlehem, Conn.

Blame a napping proofreader. The elephant stands 13 feet 2 inches high—on any continent.

Flanged Mufflers Old Stuff

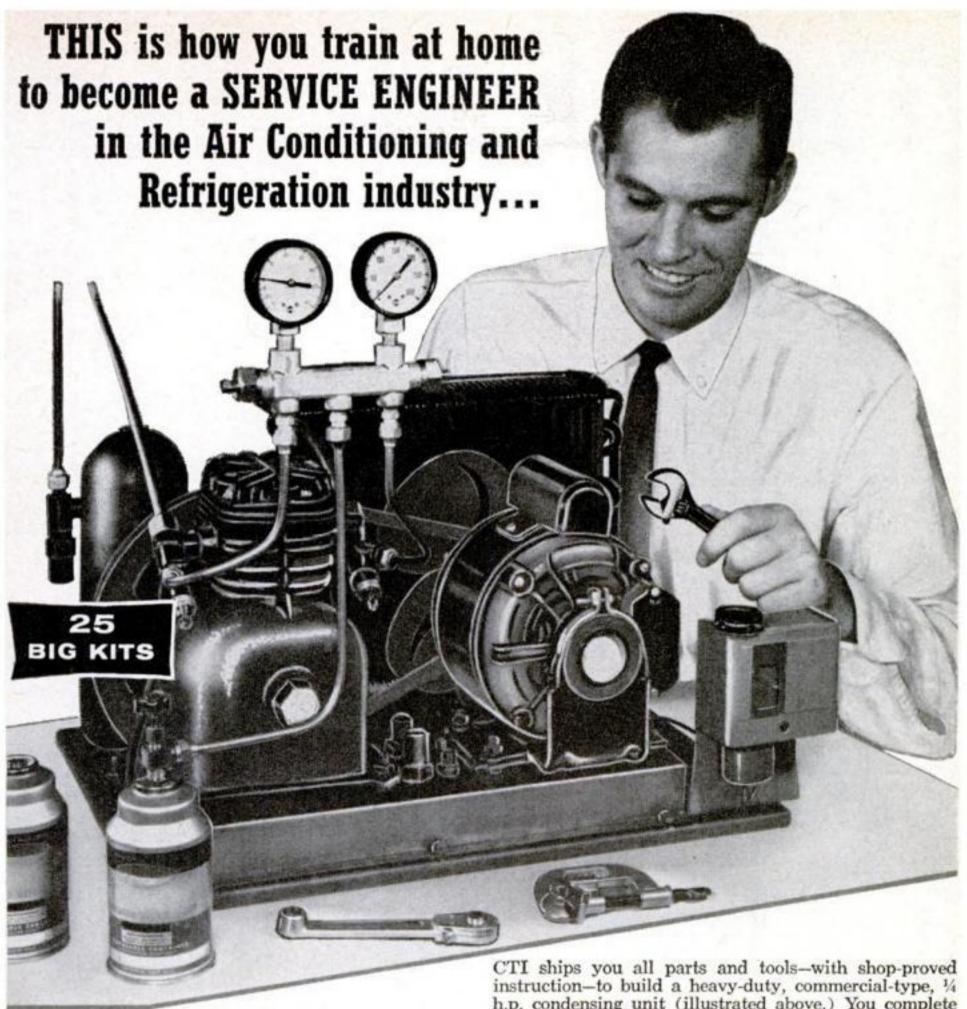
I was surprised to read the request for car mufflers and pipes with flange connections for easy replacement ["I'd Like to See Them Make," May]. What is that guy driving—a Model T?

My '56 Buick has such mufflers and either of them can be removed in about five minutes without even jacking up the car to lie underneath it.

H. E. BALLANTYNE, Miami.

. . . If Mr. Curlee is really interested in having flanged mufflers, tell him they're standard on Buicks since 1955. He can buy replacements from Montgomery Ward. They match perfectly.

A. Bruce Thomas, Baltimore.



An old industry offers bright new opportunities

Almost any industry has jobs for men with special skills. In many cases, good pay and steady work are the rule. Yet—would you be happy in being a repairman all your life? Wouldn't you rather have a job that presents a challenge-still bigger money-an opportunity to grow?

Listen, if you are ambitious to keep climbing: The air conditioning and refrigeration industry is growing so fast that 20,000 newly-trained technicians are needed each year. They can come only from the technical schools. Because installation and repair work is important, graduates may expect high pay and security right from the start. That's not all. A well-trained technician has a great opportunity to develop into a Service Engineer. As a matter of fact, 90 percent of all refrigeration engineers are former repairmen!

If you seek a career, not just a job, get into air conditioning and refrigeration. Your first step is to gain skill and knowledge. Learn at home by practicing with 25 big kits that CTI sends. Acquire experience as you train.

h.p. condensing unit (illustrated above.) You complete 23 field-type projects-do 10 trouble-shooting jobs. You make home a training center!

So practical is CTI training that many students earn extra cash in spare time soon after they start. They make calls on their own, or get part-time jobs with local appliance dealers or air conditioning contractors.

But read the complete story. It is told in a new CTI catalog. Just fill out and mail coupon below for your copy. Sample lesson included. No cost nor obligation-Commercial Trades Institute, Chicago 26, Ill.

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Send catalog, Success in Air Cond Lesson Sample. Both FREE,	oning & Refrigeration, and



...have you heard...?

How to outwit bugs: A couple of Cornell entomologists have compiled some tips to help you cope with the pests that swarm at night, or attack in the garden or on the beach.

First: Know the enemy. There are stingers and biters. Stingers attack out of sheer cussedness and won't be put off by repellents. Biters are after food, so their appetites can be blunted by chemical odors.

Wear proper camouflage: White or light-colored clothing bothers the stingers least; darker hues, most. (Beekeepers say this is a major factor when figuring the odds on being stung.) On the other hand, biters dislike smooth hard-finished fabrics so you're safer with khaki, drill or nylon. Both types are irked by textured tweedy fabrics, leathers and suedes, and thus more eager to attack.

Don't be sweet: Hair oil or perfumes attract bees. For an obvious reason: They think you're a flower.

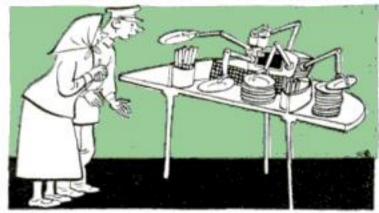
Be brave: Act coolly. Don't move a muscle. Biters and honeybees are more



inclined to charge a moving object. To flail at an oncoming bee is the worst thing you can do. Judiciously place your hand in front of your face and beat a graceful retreat.

Russians may be impressed by U. S. automation—homestyle, in the American National Exhibition that opened last month in Moscow. Among the exhibits:

 A self-propelled serving cart. It slides out of its niche in the wall, moves to the dining room to deliver silverware and plates. After dinner it is stacked with



dirty dishes, takes itself back to its hiding place where it disposes of the scraps and washes the dishes.

 A "mechanical maid." Operated by battery, this one leaves its hideaway in the wall to scrub, rinse and dry the floor. Then it goes back home, recharges itself.

Both these are remote-operated appliances that move in preset patterns. Whirlpool is the manufacturer.

On the home front, manufacturers foresee more robotry within the next decade:

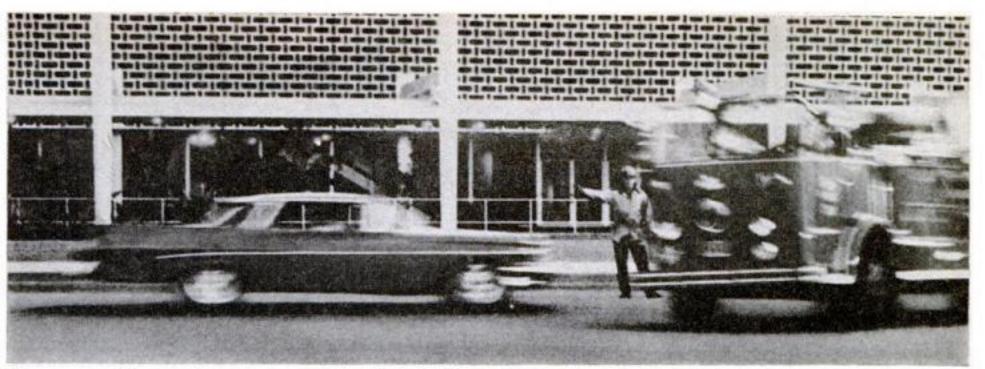
- Building bricks with thermoelectric elements built in to cool the house in summer; warm it in winter.
- Closets in which clothes would be dry-cleaned ultrasonically overnight.
- Remote-controlled stoves: A small one-channel transmitter operated by pushbutton would enable a housewife stuck in traffic to alter the temperature of a roast in the oven.
- A five-in-one laundry machine that washes, dries, sanitizes, presses and folds shirts and linens.
- A freezer-cooker that automatically moves food from the freezer to the stove, then cooks and serves it.

Are you a stickler for details? Plod along at a job setting your own pace rather than trying to keep up with half a dozen others? Take boners in your

stride? Then you may have the makings of a "creative" scientist.

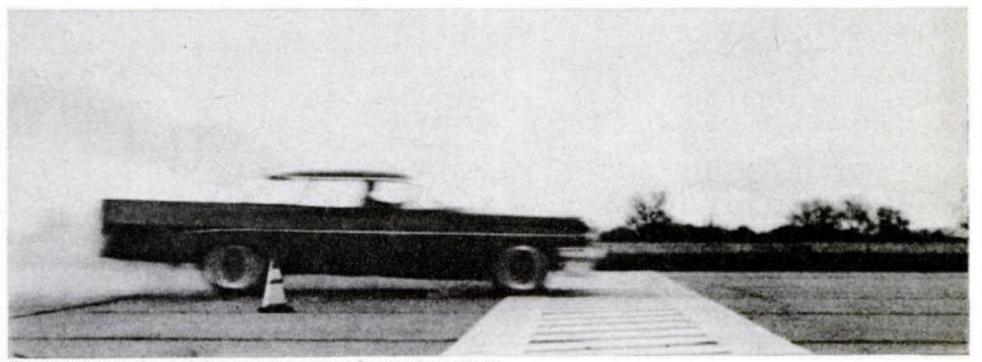
That's what Science Research Associates, a psychological testing firm, found

CONTINUED



Firestone tires deliver stopping power you need for today's driving.

FIRESTONES GIVE YOU NEW STOPPING SAFETY....



Firestone tires toe the mark in auto proving grounds emergency testing.

and this competitive braking test proves why!

Firestone Rubber-X* assures longer-lasting, skid-resistant safety.

That's one reason Firestones set the pace on automotive proving grounds where a tough testing program appraises original equipment tires. Here automotive engineers push tires to their limits of endurance. Under hurtling high speeds they measure Firestones for traction with heart-gripping "panic stops." They look for sure-footed safety on both wet and dry pavements. Through these and other comprehensive tests, they compare tires for safety, quiet, comfort and a dozen other factors that affect your driving. From firsthand experience, they discover which tires meet the exacting standards of the world's most competitive industry. That's why so many new cars roll off assembly lines on Firestone tires. Next time you need tires, remember this track-tested performance of Firestone Rubber-X—the longest-wearing rubber ever used in Firestone

tires. Buy now, on convenient terms if you wish, at your nearby Firestone Dealer or Store.



Copyright 1959, The Firestone Tire & Rubber Company



^{*}Firestone Rubber-X is compounded specifically for each type of car, truck, farm implement and construction equipment tire.

...have you heard...?

out when they studied men in the field. They picked 67 chemistry Ph.D.'s from three big companies. Of these, 33 were "more creative"; 34 "less creative"—



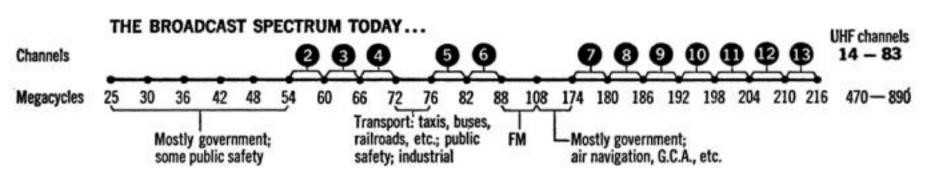
with creativity rated by the number and quality of ideas, novelty of methods, and ability to communicate results. Their findings give the lie to the stereotype scientist of shaggyhaired, baggy-tweeded, egg-on-his-vest vintage:

- The average creative scientist is in his mid-thirties. He's well-adjusted and efficient.
- He follows his impulses and drives himself hard.

- He works slowly and cautiously at first, then picks up speed as the idea jells.
- He worries less, is not so conventional as his less-creative colleague. He's not so likely to let personal or social problems interfere with his work.
- He's more dynamic, articulate and independent—sees himself detached from others.

In contrast, the less-creative man sees fewer possibilities in his job; thinks there are outside forces restricting his potential. He's more apt to think it's a weakness to pay much attention to detail. He's more likely to shirk blame for mistakes.

But on one point both agreed: When asked what would most stimulate their output, "substantial salary increases" topped the list.



"Hey, what's on Channel 90?", you may well ask some day. But first—a battle smolders, grows hotter, inside the Federal Communications Commission. The Problem? The shortage of television channel space. The Solution? Easy—add more space. The Battle? How?—without offending local stations, or the military, or you—because your TV set would become obsolete.

At present FCC establishes a 170-mile distance between stations broadcasting on the same channel; 60 miles for those on adjacent channels. In New York you're lucky. You get to choose from seven different stations. In Dayton you're stuck with two: one on Channel 2; the other on 7. Room for a third could be found if the nearby Indianapolis Channel 13 station could be limited from its 170-mile to a 100-mile range.

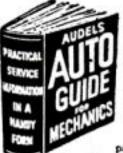
That's a proposed "interim" solution. But chances are the Indianapolis station won't like it. It means limiting its advertising potential. Other critics say the reduction to 100 miles is just a stopgap plan that'll delay what's really needed: a basic revamping of the whole broadcast spectrum.

Long-range planners are studying five proposals:

- A 50-channel system using today's 2 through 12, plus additional space. This would provide at least five stations (four commercial, one educational) in each major TV market.
- 2. A 50-channel system retaining 7-13 but dropping 2-6. (The gap between 6 and 7 is the FM bandwidth.)
- 3. A 25-channel system retaining 7 through 13.
- 4. and 5. Retain today's VHF plus UHF system, or switch to a 70-channel all UHF system. These two seem unlikely because UHF is such a dud.

But to get more space FCC must deal with the military. It's unlikely they'll forfeit all the space FCC wants. But a compromise deal will have to be worked out—and soon.

WHAT AUTO MECHANICS



This Big Practical Book gives full information, with working diagrams, covering the principles, construction, ignition, service and repair of modern cars, trucks and buses.

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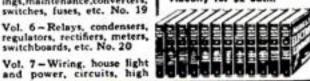
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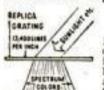
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The month in science

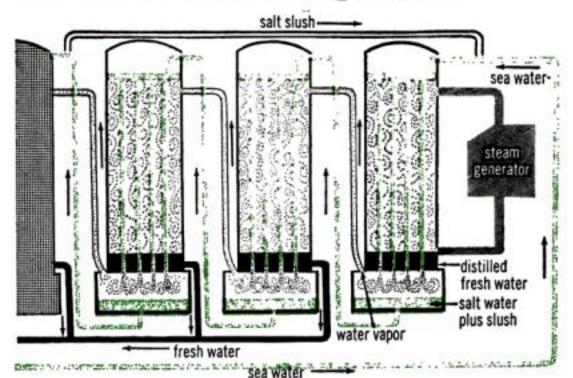
Desalting sea water by adding salt. Simple Simon's method of carrying water (in a sieve) seems reasonable and well thought out compared to the U. S. Department of the Interior's plan for getting fresh water out of the ocean. They're going to do it by making the salt water saltier. Strangest of all: It works.

The country's first "saline-water demonstration plant," to be built next year on the Gulf Coast, will use a desalting process called long-tube, vertical (LTV) multiple-effect evaporation. It is an economical process (\$1 per 1,000 gallons of fresh water now, with a 40-cent rate hoped for) largely because it avoids getting the works clogged up with scale. That's where adding salt to sea water comes in.

Anybody can make fresh water out of salt. Just boil the salt water, then cool the escaping steam to condense it. The result is pure water, all its salt left behind in the pot. But the water in the pot, continually boiling down, gets heavier and heavier with salt, and solid crystals form in the pot. That's scale. It builds up so fast that it soon clogs the works. You have to shut down and hack out the scale. And that's expensive.

The LTV process is an old standby of the chemical industry. The principle: A solid crystallizing out of a solution prefers to form on a solid crystal already there. If you put a "seed" crystal into a saturated solution, it grows larger as molecules leave the solution and solidify on it. So scale can be kept off the pot by

LTV Sea Water Desalting Process



providing seed crystals for it to form on instead.

That's just what is done in the LTV desalting scheme. Salt crystals are added to ocean water so that a slush of salt and water goes through the distillation towers. Salt crystallizing out as pure water is boiled off, accumulates on the slush, not on the equipment. The slush is pumped through a filter that takes out the big

salt crystals, then put back in at the inlet for another go-around.

The desalting plant will consist of a number of towering cylinders. Each contains a bundle of a hundred or more vertical tubes (sketch). Ocean water, with salt slush added, is fed into the top of the tube bundles. Steam surrounds the tubes, boiling the ocean water so that water vapor comes out the bottom of the tubes. This vapor goes to the next tower to heat those tubes and boil the slush inside them. The vapor that does the heating now is not steam—it's below 212 degrees. But it makes the slush boil be-

The month in science

cause pressure inside the second tank is reduced (by a vacuum pump)—and, as housewives in Denver know very well, lower pressures reduce the heat required for boiling.

This process is repeated in tower after tower: salt-water slush boiling at ever lower temperatures (and pressures), the vapor going over to the next tower to heat more salt water, some of the vapor giving up so much heat that it condenses to liquid water the sweet water that you want.

The LTV plant is one of five "demonstrations" to be built in a \$10,000,000 effort to relieve water-short areas of the U. S. (see PS, March '58 and this issue, p. 69). Plant number two, to be built on the West Coast, will use flash-distillation—boiling at very low pressures—with heat coming from an atomic furnace.

Shake those piles down. The Russians, not content with shaming our rocketmen and dazzling our dance audiences, have now shaken up our foundation engineers—the guys who install big piles and caissons for bridges, dams and skyscrapers. Literally.

American experts attending a seminar at Princeton University watched a movie run off for them by a group of visiting Russian engineers. It showed a golf ball vibrating in a jar of sand. As the ball wriggled, it sank to the bottom of the jar. The meaning sank in, too: The Russians had figured out a way to drive piles by vibrating them. The vibration method does it five or six times faster and much cheaper than banging the piles down with huge steam hammers, as done here.

The Russians use electric vibrators: motors with unbalanced weights on the shafts. Rev the motor up and it shakes wildly. Whatever it is fastened to shakes with it. If the vibrator is fastened to the top of a pile, it sets the pile wiggling down into the ground, much the way you ease a garden spade into the earth by wiggling it. The scheme works to set or remove column piles, sheet piling (corrugated steel that confines dirt around excavations) and big concrete caissons.

Vibrators are widely used in the U. S., but mainly to make bulk materials—wheat, sand, coal—flow out of railroad cars and factory hoppers. The vibrator is fastened to the side of the container and shakes it so that the contents won't clog.

How come nobody here thought of vibrating piles down? Prof. Gregory P. Tschebotarioff of Princeton, who was the Russians' American host, says that Americans have toyed with the idea but never got it to work right. The Russians did, he thinks, because they have supported long-term research on vibration, with many experts from different fields plugging away steadily.

The Americans' chagrin at being confronted with the simple technique startled the Russians. They thought we knew all about it. They have been vibration-driving piles for five years, even described their methods in 1957 at a conference in London.

One Russian engineer, talking with an American colleague at Princeton, wisecracked: "Your intelligence agents in Moscow are so busy hunting military secrets they don't take the time to stop in the street and watch a construction job."



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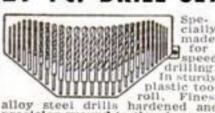
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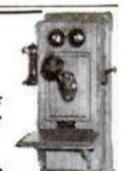
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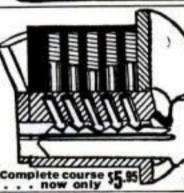
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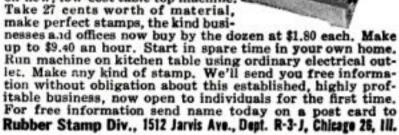
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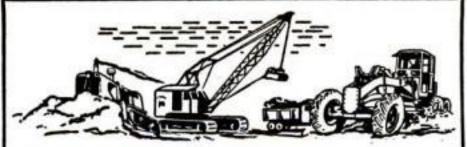


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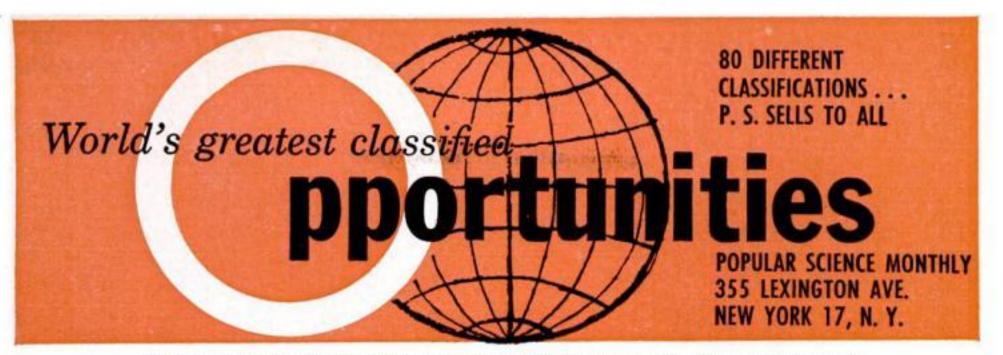
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You Do So Have to Wax It

Elbow grease is still needed on a 1959 car with so-called "super finish." You have to clean and wax it, if you want to keep

it looking its best. This word comes from what admittedly is not a disinterested source, Dr. J. V. Steinle, research and development vice president of Johnson's Wax. But he

backs it up with some convincing facts.

Dr. Steinle doesn't knock the new enamels and acrylic lacquers. He acknowledges that they are greatly superior to old finishes, don't chalk and fade nearly as much. "However, this is not to say they do not chalk or fade at all." He said that tests proved waxing improved gloss of new finishes, helped retain that gloss in like-new condition.

The snapper, Dr. Steinle reports, is that owner's manuals in many new cars still recommend periodic waxing—in di-

rect contradiction to no-waxing-needed ad claims!

You'll be hearing about Darts, new Plymouth-sized Dodges. Scheduled to appear in that Chrysler division's 1960 lineup, there'll be three series: Seneca, Pioneer and Phoenix. All will have 118-inch wheelbases (current Dodges have 122inch wheelbases). Prices: in Plymouth-Ford-Chevy range.

> Darts will be sold by Dodge dealers only, replacing Plymouths—which will no longer be available through Dodge

salesrooms.

Both V-8 and six-cylinder engines will be offered in Darts. The six will probably be a modified version of the in-line engine with pushrod-operated overhead valves designed for Chrysler's compact car, the Valiant. Other mechanical details will be similar to larger Dodges, to be offered in just two series in comparison to the three now available.

A clue to prices that can be expected on Big Three compact cars:

A very unofficial Ford source indicates that the company is shooting for a suggested list price for Falcons of \$2,047 for two-doors, \$2,117 for four-doors. What happens in steel negotiations could change this, but it shows the area the

companies are thinking of.

The word on Falcon performance is that engineers have been shooting for an acceleration target of 19 seconds from a standstill to 60 m.p.h. This is just a shade slower than current Big Three sixes with automatic transmissions.

The switch to unitized construction will enable Chrysler to get back close to its long cherished "chair-high" seat concept in 1960 models, while retaining low silhouettes.

Since Forward Look cars appeared, the corporation has been stung by complaints about too-low seats from custom-

[Continued on page 196]

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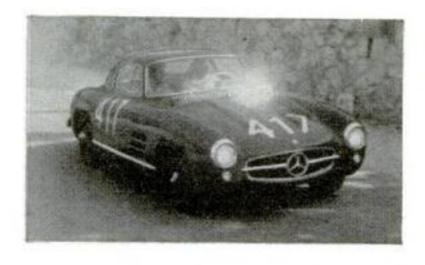
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How to Drive and Stay Alive



A top sports-car race driver gives you his 14 commandments for survival

BY E. D. FALES JR.

OW does a racing driver—or anyone else—stay alive on today's car-smashing highways? I put the question to John Fitch, one of the world's top sports-car drivers.

It's an important question for two reasons: 1) the chances that you will crack up your car this year are incredibly high: 1 in 8, according to the National Safety Council; 2) in spite of these insane odds, Fitch, in more than 20 years of driving, has never had a crash on a public highway. Obviously, he has something that the average driver doesn't. Sure, Fitch has crashed in races. He's had his "bumps."

Once in France he was tossed off a curve at 120 m.p.h. The police said his Cunningham rolled over at least a dozen times, and bounced end over end three times. They ran to pick up Fitch in little pieces and found—no Fitch. Far away they saw a long-legged guy hotfooting it through the fields as fast as the wind.

I spent some time riding with Fitch on New England roads, noting how his driving differed. Here's what I learned. Fitch has 14 commandments that keep him safe:

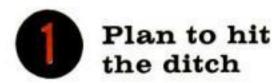


Race driver John Fitch and author Ed Fales check their route.

Follow these rules to safer driving



"Taking a trip today is like crossing



"When I'm racing," Fitch said, "one part of my mind is always appraising the sides of the track—both sides. I've trained myself to do this without conscious effort. Most race drivers do. We're always looking for 'escapes'. I do this on the highway, too. I've hit the ditch several times, and that's why I am alive."

The average fellow, John told me, never thinks of running off the road.



All his effort is tuned toward staying on it. That's why we have those terrible early-morning head-on collisions that wipe out whole families. A drunk comes down the wrong side—and the other fellow doesn't take off into a field.

"A motorist should practice this in his mind," Fitch said, as we left his home in Lime Rock, Conn., and headed for Albany, N. Y. "As you drive, train your eyes to see every 'sudden-escape' route into fields, up hillsides, across ditches, into barnyards.

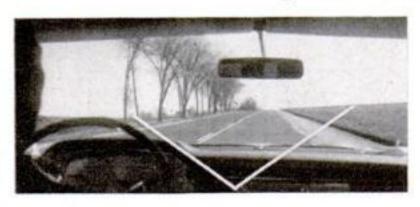
"Alert your mind to 'sudden stoppers'. These are the killers: concrete abutments, deep ditches that roll you over, power poles, rock ledges—and any trees over eight inches thick. (I'd like to stress the absolute necessity of avoiding trees of this size.) Keep practicing subconsciously how you'll miss these stoppers and swerve up a bank, between trees, over shallow ditches. Then when a crash comes heading your way, you can hope to run away from it."



Adjust speed for your "escape cone"

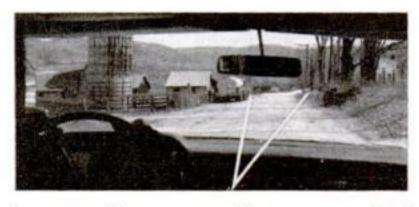
Most good racing circuits have built-in "escapes"—emergency run-out areas. When a driver approaches a turn that has no escape, he guards against the slightest mistake. Usually this means reducing speed. Motorists, says Fitch, should follow the same policy.

Let's say you're doing a legal 60 on a fine road. No houses. Open fields on



both sides. You are now driving in what might be called a wide "escape cone."

Then a farmhouse appears on the right. The cone narrows. "I'd knock off five m.p.h.," said Fitch. Now there's a second farmhouse on the right, barn on the left.



The cone becomes quite narrow. Take off another five m.p.h. Anything—a dog, a child, a tractor—can suddenly puncture your cone of safety. You are in danger above 50 m.p.h.

If a car comes toward you in that narrow cone, the cone is squeezed down again. "I'd probably cut my speed to 45, a full 15 m.p.h. under the limit," said Fitch.



Use your headlights in the daytime

Racing in broad daylight, in 1955, in Italy's dangerous Mille Miglia, Fitch was annoyed. Three times, at pit stops, committee members handed him notes saying: "Your headlights are on."

"I know they're on," Fitch told them. "I put them on—because I want to be seen."

To survive on today's roads, Fitch says you need to be seen, too. You need all the attention you can get. We en-

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a battlefield—they're shooting at you"

tered New York State on twisting, hilly Route 199. It was a cloudy day and Fitch, wheeling my car along, switched on the lights. We kept meeting cars that crowded us on tight turns, and sometimes their wheels got on our side of the center line.

Not so after we began using lights. The first car we met whipped toward us a good 18 inches on our side of the road. As our headlights flashed around the turn he hauled his car back where it belonged. This happened several times. Obviously, headlights get you faster split-second recognition on turns—at least on cloudy days.

"Have you ever noticed," Fitch said, "that even some railroad trains now use headlights all day long? They want to be seen sooner by motorists using the grade crossings."

Fitch was one of the first racing drivers to use headlights. Today many put their lights on during a race.

Fitch doesn't recommend headlights in bright sunshine. But on cloudy days and



on twisting roads, they add a safety element. The car that sees you only a splitsecond faster is much less apt to clobber you.

Over the years, passing millions of cars, you're improving your chances of survival. Headlights, too, will get even a drunk's attention sooner!



Know how to rub off speed

"In racing," said Fitch, "I think in terms of energy absorption if a crash looms." Fitch and I had been discussing this when a curious thing happened. We heard a crash like thunder, but with a metallic ring. It startled us.

In a car two blocks away, a little boy had fallen asleep in his mother's Pontiac. Trying to keep him from falling off the seat the mother veered off the road. The car headed straight for a "sudden stopper"—a deadly concrete abutment. But first the car hit a row of small posts.



These bent in the ground, drinking up energy and actually boosting the car two feet in the air—which drank up still more energy. "A perfect example of energy absorption," said Fitch. The young mother and son climbed out safely. They didn't know how lucky they were. If the car had hit the abutment squarely, they might have been killed.

"A driver," said Fitch, "should always be looking for small trees or posts, earth banks and the like, on which he can rub off speed if something goes wrong. One man I know laid his station wagon on its side in a snow-filled ditch and rubbed his speed down when he skidded from a road. If he hadn't done this he would have hit a concrete culvert—and might have been killed. Parked cars also can be used to rub speed off if your brakes should ever fail on a steep hill in town. But be sure to rub them; don't hit them solid."



Adjust speed for lane width



I noted that Fitch almost always changed his driving speed when the effective road width changed.

Near Sheffield, Mass., Route U.S. 7 is built of two parallel 10-foot wide

concrete slabs. Suddenly we came to a spot where the slabs narrowed to nine feet. Fitch chopped off five m.p.h.

"Many drivers," he said, "hold the same speed regardless of slab. I drive faster on a wide slab, slower on a narrow one. The narrow one crowds you closer to the other fellow. You're often passing him, inches away, at a combined speed of 120 m.p.h. No driver is so good that this can be safe."

I noted too that Fitch dropped his speed on a crowned road, increased it on a flat one. "Less stability on a sloping slab," he explained. "In racing, I am cautious if my car feels the least bit unstable. I carry this over into my highway driving, too."



Pull off the road for an emergency fix

When something goes wrong that forces you to stop on a race track, says Fitch, the first rule is: "Clear your car!" This means: Get it off the road. It means get



it so far off that no other car can possibly

hit it—even in a spin out.

"This," said Fitch, "is something motorists haven't even begun to learn. Some still stop right in the lane to fix a tire. Others pull off, but only partly. A few pull all the way off—and then kneel down with their bottoms out in the road. A racing driver knows that getting that close to traffic is suicide.

"Clear your car even if you have to drive 200 yards on a flat tire to find a turnoff. This will ruin your tire, but go ahead and ruin it. It's better that way. Anything that stops on a road today is apt to get hit."



Use a longer radius on turns

In a race, Fitch enters a turn wide, cuts it fine at the apex, and finishes wide.

I noticed he does this on the highway, as well.

"Gives you stability," he said. "The



average driver tries to stay to the center of his lane all the way around. I hug the edge of the lane at the middle of the turn." This flattens the radius, making it easier. (The driver who does this on a *left* turn should be careful, naturally, not to get too close to the center line.)

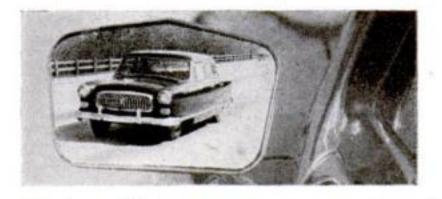
Fitch wishes that some drivers would get rid of the idea that full throttle can pull you out of any turn you've hit too fast. This notion, he feels, has caused

many accidents.

"Ninety-nine times out of 100," he said, "the driver ends up turning a minor embarrassment into a disaster. While I don't subscribe to violent braking on a turn, gentle braking will cut speed without throwing you into the ditch. If I ever did find myself sliding wildly into a turn, with only a thread of control remaining, I wouldn't brake for fear of losing an iota of side traction. And I certainly wouldn't accelerate either, for the same reason."



Always keep a sharp rear guard



Racing, Fitch almost gets cross-eyed keeping one eye on the track and one on the mirror. If mirrors wore out he'd be changing them at every pit stop.

"You can't take your eyes off those boys behind you for a single minute," he said. "In a race they're charging down on you at 100 to 170 m.p.h. On a highway, they're barreling toward you at 50

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to 70. No motorist should ever forget this."

Fitch rides his mirror every inch of the way. At night his rear guard is doubled. He goes on a sort of alert whenever headlights seem to be overtaking him too fast. This might be just a fellow citizen going somewhere in a hurry. But it could be a wild-running drunk.



Lay well back before you pass

I noticed that Fitch, unlike many drivers, never creeps close to the car ahead before passing. He usually begins his passes 50 or 75 feet back. "On the highway I ease out early for several rea-



sons," he said. "I want to clear my view before I begin the pass. I want to be able to see a long way ahead. And I want to be able to run up my momentum so I get

the pass over with fast.

"The reckless or dreamy fellow who shaves your rear bumper pulling out to pass you is going to have to gun his motor hard in order to get ahead. This sudden gunning throws his car off balance and he loses stability. If he has to cut back sharply, brother, you're both in a jam.

"I have actually seen several of the higher-powered American cars go completely out of control during full-throttle passing. The combination of light-loaded rear wheels, the automatic selection of the optimum gear ratio, and powering out to pass has suddenly broken traction,

and sent the car sliding."



Hold down your speed when passing

Here's where John, on a highway, departs from his racing routine. On a track doing 140 in a Ferrari, he may pass an MG doing 100—with a 40-mile passing

differential. That's race-track driving.

"But on the road," he said, "I always cut speed to hold my passing differential to 10 m.p.h. If the lad ahead is buzzing along at 40, I never pass him at over 50.

"There are two reasons: 1) a driver ahead on a race track is fairly predictable, but on a road he's as unpredictable as a psychopathic cat; 2) if I should happen to bump him, I'm hitting him at only 10 m.p.h. But if I'm doing 60 when I bump him, that's like hitting a stone wall at 20 m.p.h."

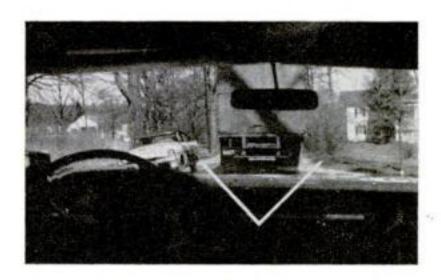


Be alert for the "cone of blindness"

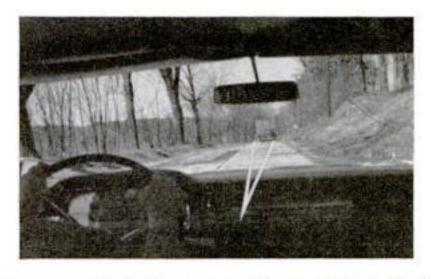
Back in Connecticut, we followed a truck on Route 44. Another car was directly behind the truck, hanging on to his rear bumper.

Laying 200 feet back we saw a car coming toward us. The fellow behind the truck couldn't see it, pulled out, and nearly cracked up.

"His entire driving vision is blocked," John said. "He's driving into a wide



'cone of blindness.' Back here where we are, the cone is very narrow. I try to stay as far behind another vehicle as I



can—so that the cone of my vision that he blocks off is very small."

[Continued on page 188]

Russian Propaganda Twists

Last August, Popular Science ran this news item—just as it appears here



Bulletproof "robot." Put a man in this goggle-eyed science-fiction suit, and he can walk into a shotgun blast and barely feel it. It's fiber-glass and plastic, resists bullets like quarter-inch steel. Ports open for defense weapons, vision is through bulletproof glass and "eyes" are spotlights. Independent Engineering makes the suits for Detroit police.



ИЗОБРЕТАТЕЛЬНЫЕ ДЖЕНТЛЬМЕ

Среди папостранай в вигрицаскои журевае «Попилар дайняс» обращеют на собе визиания для фотосилым вод заговочное «Робот, устойчений протие пуль».

Что не означен выбражение н

Мализаное поисмения Нараду с другими помыше материальных современных пометами венечательный вид сфинетия видетиков—пометами вид сфинетия видетиков—пометами и пометами венечательными пометами венечательными пометами венечательными пометами венечательными пометами венечательными венечательным

мах стеменных постоим, во пробивоет прав.

Пона еще иет сведений, у казы поступкия от прения Кактов в «Анкернандского Но с детройтской полицией общиет «Понятом» бириа «На раджатевренг» катогомият расройнымение костиона. С тройтскам шляня смогут не рабочке собрания и негр домя с незыканы роском савте.

На сивмие слево-пример комплото изделия фермы об деят зидилизориять, справа издет. Из отверстий и не изделийся на уровые порт вести отома. Демонстриру ме оопумильного верей .



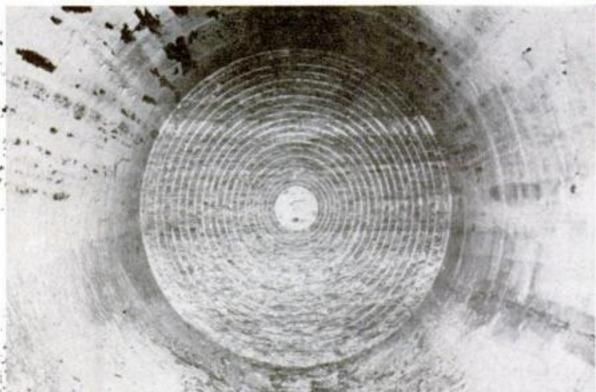
пудесных редей, авторые обличания бы в украили долже веления!

Дистинения по дверживания фармы обличательных вединирания операла другия деят вединирания ENTERNMENT INSTRUMENTS REPRESENT CASE CASE DETERMENTARIES, & MANAGEMENT AND ADDRESS OF MANAGEMEN

то Сим-Сим фотовлениямия, в инитов, получаенных из работые изтинги и собрания, некропностически на рацины и милектофиции, умев манидимия и милектофиции, уметак что в неконтофиции изращие. Так что в неконтофиции



A Russian newspaper lifted the photos —without permission and printed its own story





MECHANICAL MOLE. Concentric rings at the end of this tunnel were made by teeth (one being welded above right) on the revolving 29½-foot head of the machine on the facing page. Rock is bored by tungsten-carbide bits on a rotary head of hard-faced steel alloy. It is removed by con-

Popular Science News Item

A RECENT issue of the Russian newspaper Promyshlenno Ekonomicheskaya Gazeta (Industrial Economic Gazette) pirated the pictures from a PS newsitem, and accompanied them with a wildly distorted story. Translation, by the Slavic Scientific and Technical Library of Boulder, Col., follows:

Resourceful Gentlemen

Among the illustrations in the American magazine "Popular Science," two photographs under the heading "Robot Is Bullet-proof" attract attention.

What is the significance of what one sees

portrayed in these pictures?

A little explanation. Along with other new materials, modern technology has created a remarkable kind of laminated plastics—polyester glass laminates, which have wonderful qualities. This material is tougher than steel and lighter than aluminum. It has high sound absorption and permits up to 85 percent of the light to pass through. Water, salt solutions, gasoline and oil have no effect upon it. Everyone who becomes familiar with this material will say: how many wonderful things which would make life easier and more beautiful could be produced from it!

But a different idea flashed into the minds of gentlemen from the American firm "Independent Engineering"; wouldn't it be possible to use the laminates in such a way that one might himself remain alive while killing

other people?

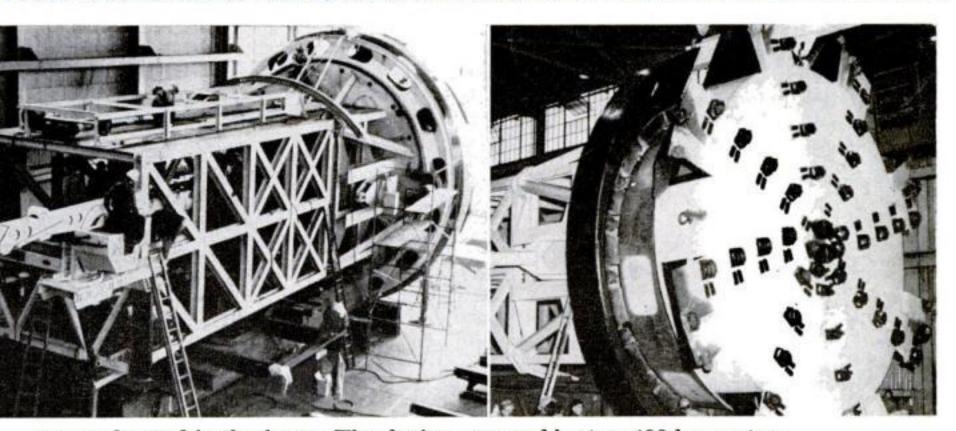
And here is the result: the firm, in a move toward meeting the ardent desires of gangsters, Ku Klux Klan members and gendarmes, has developed the manufacture of polyester glass suits which cannot be penetrated by bullets.

There is still no information on how many orders have been received from the successors to Al Capone and from the "American Legion." But "Popular Science" reports that a contract has already been signed with the Detroit police. The "Independent Engineering" firm will make puncture-proof suits for them. Soon the Detroit police spies will be able to attack workers' meetings and Negro homes with less risk of being hit back.

Shown in the photograph at left is a man trying on the tailored product of the "Independent Engineering" firm. At right the suit is shown being worn. It is possible to shoot from the openings in the suit located at belt level. In demonstrating the quality of this original attire, one gentleman is trying to riddle the other with bullets. Marks made by the impact of the bullets can be seen clearly on the protective suit. After more than 10 shots the "gallant fellow" still stands on his feet as if nothing had happened.

Enlightened jailers and administrative clerks are always attracted to technical innovations. They have replaced the crude, unsystematic gallows with the elegant, high-voltage, electric chair. They have equipped the doors to Sing-Sing prison with photocells. They have provided police spies, who are sent secretly to workers' meetings and gatherings, with tiny radio transmitters and sound recorders which can be put into a coat pocket.

So you see there is really nothing out of the ordinary in the innovatory research of the "Independent Engineering" firm.



veyors housed in the frame. The device, powered by two 400-hp. motors, is pushed forward by hydraulic jacks on hinged side arms. Digging water-diversion and power tunnels at the Oahe Dam project in South Dakota, it has shattered and burrowed into shale at 12 feet an hour.



The Awesome Miracle of

Destructive but essential,

By Ira Wolfert

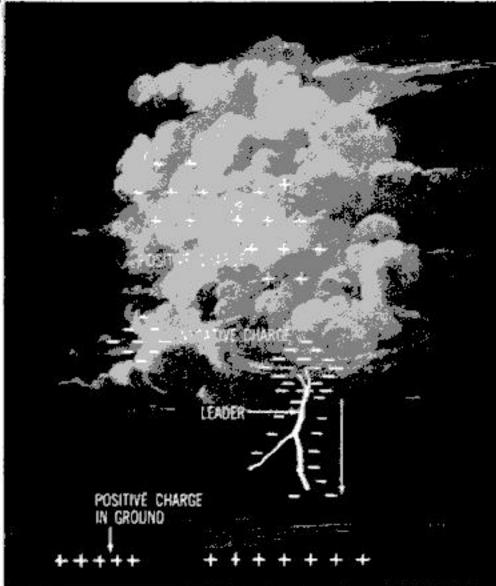
HEN you see lightning, it has already missed you. When you hear thunder, relax; the show is over. The noise is just the audience rushing for the exits.

One of the great figures in thunderstorm exploration, the late Dr. Karl B. McEachron, used to reassure nervous laymen by telling them these facts—all scientifically true. Lightning moves about 30,000 times as fast as a bullet. If a big stroke were to hit you, you'd never know it. In the meantime, enjoy the spectacle.

Lightning is both a blockbuster and a boon to mankind—one of the most dramatic examples in nature of the ill wind that blows good. It is true that it kills more people in the United States than any other natural disaster: an average of 400 dead and 1,000 injured every year, according to Census Bureau reports. It destroys 37 million dollars' worth of U. S. property annually—and this figure does not include the losses from some 7,000 forest fires started by lightning. Yet it is also true that without lightning, plant life could not live.

Eighty percent of the earth's atmosphere is nitrogen—an essential food for plants. About 22 million tons of this nutriment, worth about \$300 a ton, float over each square mile of earth. But it's pie in the sky; for in its aerial form, nitrogen is insoluble, unusable. It's locked up, chemically. Before plants can take their sustenance from it, it must undergo what our food undergoes in our digestive machinery: a series of chemical reactions. Lightning touches off the series.

This extraordinary process was described for me by Dr. M. F. Fogler, executive vice-president of the Nitrogen Division of Allied Chemical & Dye Corp.



Violent movement of water droplets and ice particles inside cloud separates electric charges to make top positive, bottom mostly negative. This causes ground under cloud to acquire positive charge. Eventually, electricity reaches downward from cloud in "leader" stroke.

Air particles are made white-hot when stroked by lightning. They reach temperatures as high as 30,000 degrees C. Under this intense heat, the nitrogen combines with the oxygen in the air to form nitrogen oxides which are soluble in water. The rain dissolves the oxides and carries them down to earth as dilute nitric acid. You can smell this acid—the pungent, tingly odor that hangs in the rainy air of a thunderstorm. Reaching the earth, the nitric acid reacts with minerals in the soil to become nitrates on which plants can feed.

Here is a wonder indeed: Lightning, which meteorologists estimate to be bombarding the earth at a rate of more than

Lightning

lightning gives life to earth by supplying plants with nitrogen





MAIN BOLT STRIKES UP. As atoms in air ahead of leader break down into negative electrons and positive ions, positive ions flow up toward cloud. This is the "streamer," the very bright and powerful flash of electricity. It meets the down-hanging leader to make a continuous path for current from ground to cloud.

MOST BOLTS STRIKE TWICE, some even 40 times, as different concentrations of charge flash new "dart leaders" along path of ionized air created by first discharge. The new leaders trigger upward streamers of their own, still along original path. The multiple discharges come so close together they seem to be one.

100 times a second, transforms the upper air into fertilizer for earthbound plants! At their present rate it is estimated that thunderstorms deposit in the earth about 50,000 tons of nitrogen a day!

The story of lightning is one that sings between the lines of the greatness of science. Every American child knows that the story began with Benjamin Franklin and the kite that led to his invention of the lightning rod. That simple device, basically unchanged since Franklin's day, must be included in any list of great inventions and credited with having saved countless lives and property. But flying the silk kite in a storm was only an incident in six years of work

on thunderstorms, resulting in discoveries that made the great English scientist Joseph Priestly hail Franklin as "the greatest" since Sir Isaac Newton.

Very little more was learned about lightning until an August afternoon in 1920 when a bolt struck a gnarled "snake tree" a foot away from an unoccupied lakeside shack owned by Charles P. Steinmetz, "the wizard of General Electric." The bolt bounded off the tree and broke a window; it splintered a work table, then leaped across the room and shattered a mirror.

Discovering the debris, Steinmetz had every fragment and splinter of the mirror collected and fitted together between two sheets of glass. It was the first time that the pattern struck off by a lightning charge had been studied.

The broken mirror sparked a perilous exploration. Now scientists devised instruments to measure and record bolts. They hunted lightning, trapped it in bottles and on film, learned how to make it in the laboratory, then how to carry it with them into the field so that they would not have to wait for weather to study its behavior. They even developed a camera that takes what amounts to a high-speed, slow-motion picture of a lightning bolt, exposing its separate strokes.

Scientists were urged to make these

studies because of the growing dependence on electric power. Lightning plays rough when it hits electric lines, and it hits them frequently. (In the Midwest every mile of a 100-foot-high power line is hit once or twice a year.) Lightning can run along the line directly into expensive machinery in the powerhouse or transformer station, or-if it makes an arc to the ground before it travels that far-it will be followed by all the electricity in the line until the line is drained or shut off.

The scientists eventu-

ally learned how to control the power failures. But to do so they had to find out how lightning is made. Rarely have explorers venturing into previously unknown parts of the earth brought back a more dramatic story of natural wonders.

To begin with, a thundercloud gets under way when warm, humid air rises from the earth in a steady updraft, generally over a hill or mountaintop. The humidity condenses as the air cools on rising. We see the tiny water droplets as mist which gradually assumes the familiar shape of a cumulo-nimbus cloud. Sometimes looking like a huge cauliflower, sometimes in the shape of an enormous white anvil, the cumulo-nimbus is often topped by the "cirrus umbrella." It is composed of billions upon billions of minute crystals of ice.

These formations can be enormous up to 50,000 feet in height. They can contain as much as 300,000 tons of water. In them is a so-called "chimney current" —a column of air rising at a full gale force of about 100 feet a second. The moisture in this column condenses rapidly, and the droplets are swept upward to freeze into hailstones. The hailstones do not fall. They dance on the chimney current like celluloid balls on a gushing fountain, rising steadily higher until, near the top of the cloud, the force of the current is exhausted. There the hailstones shower out in all directions, carrying

cold air with them as they descend. Frequently they are sucked back into the chimney current on the way down to be dissolved and reformed again and again.

In this turbulent mosomething tion still unexplained happens. There is a separation of electric charges. The smaller particles near the top of the cloud become charged positively, while the raindrops in the lower portion of the cloud are charged negatively.

Meanwhile, on the surface of the earth directly below the cloud there is a correspond-

ing build-up of a positive charge. It forms a mirror image of the cloud. As the cloud drifts, carrying the negative electrons with it, the positive charge on earth follows it like a shadow, climbing trees, church steeples, towers, poles. It races into houses and climbs chimneys, water pipes, TV aerials, lightning rods—whatever can bring it closer to the cloud.

Enormous differences of electric potential develop between the top and bottom of the thundercloud, and between the bottom of the cloud and its image on the earth.

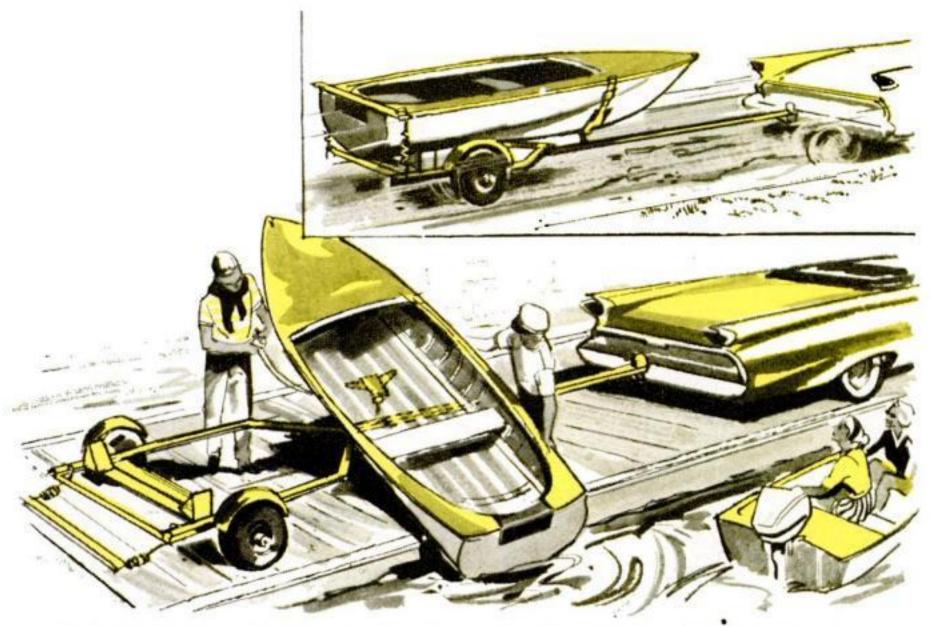
Suddenly a thin, white arm reaches down for perhaps 50 feet from the base of the cloud—a "leader." It is a gaseous arc path, reacting to electricity like the



LIGHTNING RODS PROTECT a model house against man-made strokes in Westinghouse laboratory. Franklin's great invention prevents damage by channeling bolt's tremendous current into a safe path to the ground.

[Continued on page 186]

New Ideas from the Inventors



1 Swivel Trailer Floats Boat. Two padded, spring-supported cradles on this recently patented trailer would secure a boat, cushion it against road

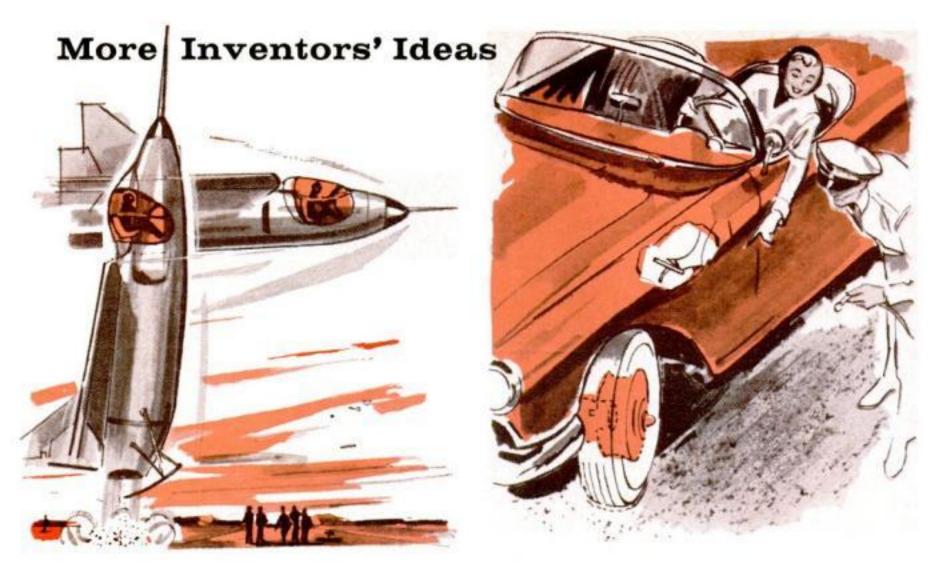
shocks, and simplify handling in or out of water. Swiveled on the forward cradle, a boat could be more readily loaded or offloaded over the edge of a beach or dock.

2 Platform Extends Car Trunk. You'd have more room for extra or outsize luggage with this slide-out trunk extender and its bumper-braced supports. Folded in, the platform would become a raised floor that could cover a spare tire, hold ordinary trunk-carried gear.

3 Candy Makes Kids Say "Ahh." A flavorful candy coating on one end of a wooden tongue depressor should make throat examinations pleasanter for both doctors and their younger patients. For still further solace, a child would usually get to keep the medical lollipop.





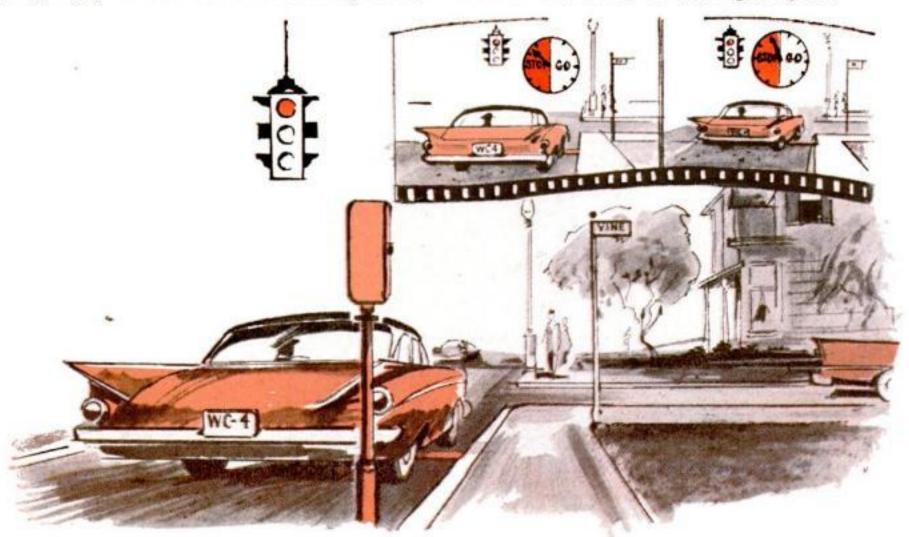


4 Seat Levels Jet Pilot. The pilot would sit upright in this VTO jet both while it was taking off vertically and flying level. Automatically adjustable through a 90-degree angle, the cockpit, controls, and seat would remain level regardless of the inclination of the plane.

5 Air Brakes Inflate Tires. You'd never need gas-station air-pump service if you could regulate tire pressure by pedaling the brake. These disk brakes and tubeless tires would share the same air supply. Replenished as you drove, valves would maintain any preset level.

6 Camera Traps Light Jumpers. To obtain reliable evidence of traffic violations (and thereby discourage light jumping), this inventor would synchro-

nize a camera, clock, and traffic light. Two sequence films, like those shown, would automatically record a car's movement in relation to the light cycle.





7 Claw Pulls and Catches Nails. You wouldn't have to sweep up scattered nails and spikes if your hammer had a receptacle like this clipped just below the prongs. It wouldn't interfere with normal claw action and pulled nails would fall (or be prodded) into the container.

Wertical Wipers Wipe Blind Spots. Horizontal wiper blades, moved up and down by plungers, might banish the rainmisted arcs left by conventional wipers. The blades could lap at the center, span the full width of the glass, and conform to wraparound curves. Linked to the plungers by bent rocker arms, a conventional motor would drive the wipers.





9 Belt Switch Frees Your Hands. You could snap a flashlight on or off by extending or relaxing your stomach muscles if it was wired through this switch. Designed for momentary, no-hand control, the belt switch could be used with battery-powered tools to supplement regular, sustained-operation switches.

The following patents have been issued on these inventions:

1. Patent No. 2,765,180 to Charles J. Albers, Center, N.D.; 2.

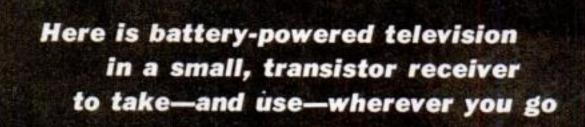
No. 2,772,041 to George J. Zeabari, Detroit; 3. No. 2,857,908 to Leslie S. Cornfield, Los Angeles; 4. No. 2,868,477 to Herbert E. Chaplin, Hayes, England; 5. No. 2,866,525 to Arthur W. Bauer, Omaha; 6. No. 2,871,088 to Frank Abell, Inglewood, Cal.; 7. No. 2,768,809 to Belle A. Kandarian, Fresno, Cal.; 8.

No. 2,677,844 to Daily McGlasson, Sr., Benton, Ill.; 9. No. 2,681,955 to Wilbur M. Davis, Brooklyn.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient. you may address him (by name and patent number) in care of the Commissioner of Patents.

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First Really



By Martin Mann

They've built a TV set you can take with you: a genuine portable—battery-powered. You no longer need a power cord, or an

outlet to plug it into.

It works just about anywhere except under water. You can go to the beach without missing the ball game, enjoy Lawrence Welk from a canoe, catch Jack Paar while camping out or, more practically, keep a child quiet in the back seat on an auto trip.

Philco is first, by virtue of remarkably imaginative engineering. Its production lines are now stamping out the Safari, a leather-covered,



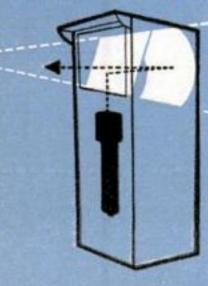


Image behind set—four feet away—is created by concave magnifying mirror. Front mirror—half-silvered reflects picture tube to it, also lets you look through.

Portable TV

transistor-packed shoebox that does tricks with mirrors (honest!) to make a respectably sized picture even in seashore sunshine.

The Safari portable weighs 15 pounds, measures about $8\frac{1}{2}$ by $16\frac{1}{2}$ by $5\frac{1}{2}$ inches. The picture area is 80 square inches—same as an ordinary 14-inch screen. It runs on batteries (which can be recharged at home) or on house current. The price is not outrageous for such a seductive adult toy: \$255.

The other TV-makers are close behind. All have been teasing the public with handbuilt experimental models. GE and RCA expect to get into production by winter. The Japanese, who have come to be darn clever with transistors, may beat that schedule. The hottest rumor has Toshiba selling battery TV sets in the U. S. this summer—and for around \$125.

Who needs it? Americans like to move around. And they insist on The set, shown here life-size, makes a picture bigger than itself—the size of this outline

Mirrors turn the trick: From small tube, cheap battery, they make a big picture you can watch in bright sun

taking their entertainment with them the magazine rolled into a pocket, the portable radio held at ear level.

Carry-along TV is a natural addition. Even at home, it's a convenience: You can take it out into the back yard, or simply move it from room to room without crawling around stabbing at an outlet.

But the manufacturer's motive for gambling a million or so on such a new product can be considerably more complex. He may hope that (a) people will buy the gadget because it is a Practical and Useful Convenience; or (b) people may not need the gadget but will buy anyway because it is The Thing to Do, like dancing the cha-cha-cha; or (c) people will come into the store to see the Amazing New Invention and end up buying something else he wants to sell, as they look at convertibles and buy sedans.

What's so difficult? All the big electronics labs have had orders from above: Make us a salable transistor TV set. The resident geniuses failed to deliver, until now, for three very good reasons:

 Picture tubes were too bulky, too heavy, and too hungry for electricity.

2. Batteries were too bulky, too heavy and too weak—unless very costly.

Transistors for the very high frequencies of television circuits were too expensive, mainly because they couldn't be manufactured uniformly.

Problem number three is in hand. Philco has geared up an automatic assembly system that cranks out transistors more than a third cheaper than before. Even so, a Safari contains 60-odd dollars' worth of transistors.

Recent developments in rechargeable batteries ("Clever New Gadgets Run on Flashlight Batteries," PS, March) ease the power bind somewhat, although hardly enough to suit the TV designers. They don't make batteries, and can afford to be unreasonable. The Philco set contains a package of five cells (labeled Philco but made by Eveready). It goes four hours between charges, can be recharged maybe 20 times, and costs around five bucks to replace when it's finally shot—about six cents an hour for power.

This is a pretty small battery. The

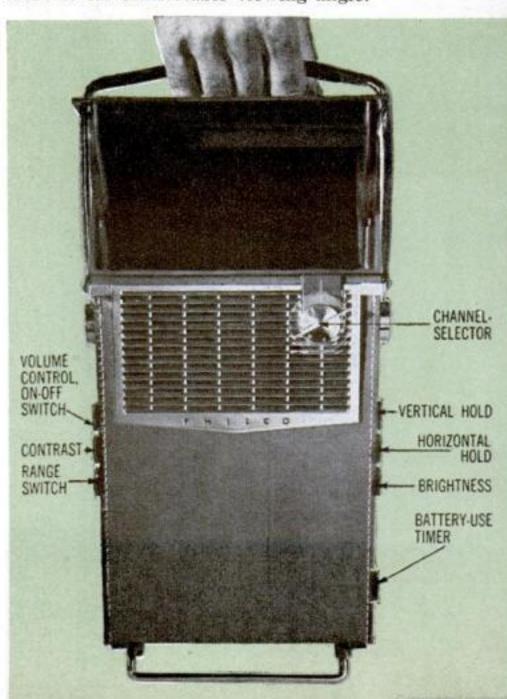
portable TV set draws only 4½ watts—a living-room receiver draws 200. Philco gets away with it partly by prudent design (project engineer Al Curll remarks, "We wouldn't dream of adding a pilot light"), but mainly it's because of a unique solution to the picture-tube problem.

The ideal solution would be a solid picture tube, built like a transistor to operate on a trickle of power. So far this is still a gleam in the eyes of the long-hairs who practice quantum mechanics.

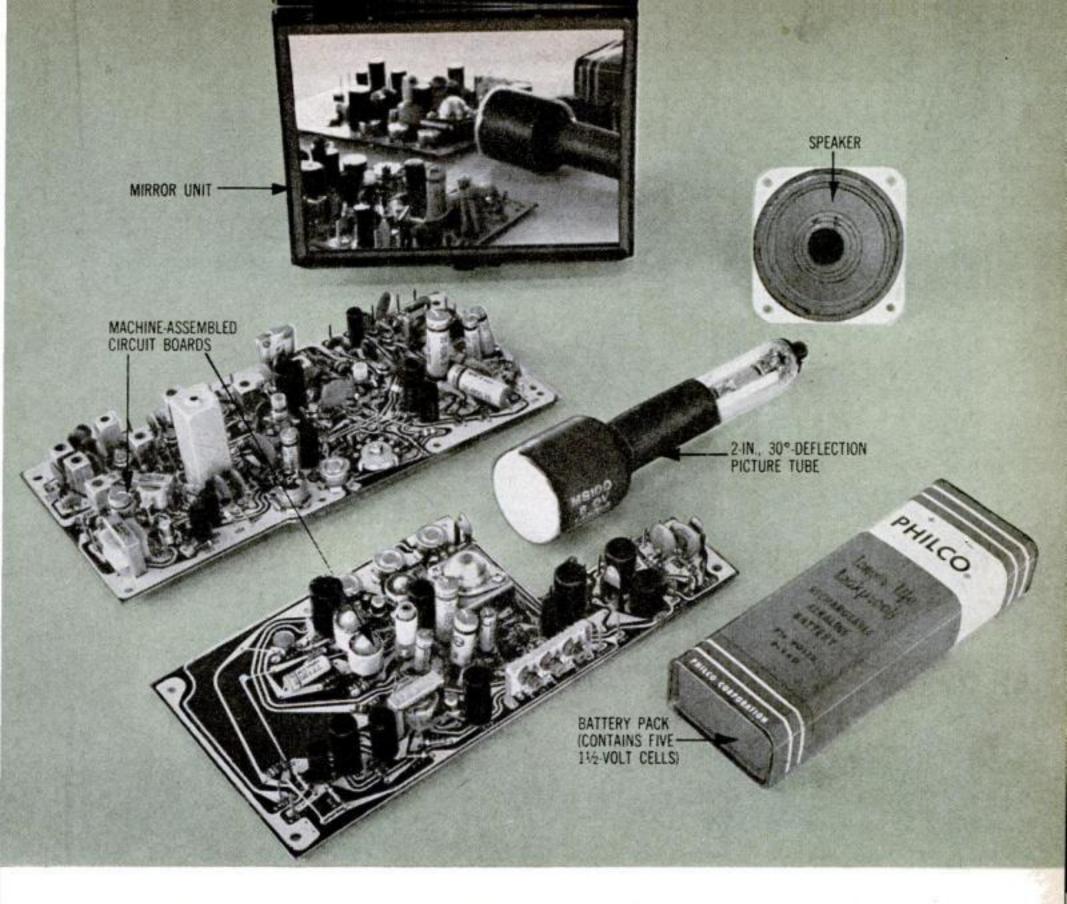
Philco finessed. The bright idea came to research v-p Dave Smith when he was flipping through that standard source of inspiration, the Sears, Roebuck catalogue. He saw Sears' slide viewer.

The slide viewer is a \$10 optical gadget that shows you an enlarged image of a 35-mm. photo transparency when you hold it up to your eyes. The picture

COMPACT AND LIGHTWEIGHT, Philco's Safari is a bit larger than a shoebox, weighs 15 pounds. Most of bulk is accounted for by mirrors, picture tube and battery pack (opposite page). Transistor-studded boards form sides of chassis. Visor (shown up) shades viewing system, protects it when closed. Brass stand adjusts to tilt receiver for comfortable viewing angle.



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seems to float in space some distance behind the viewer. It is a "virtual" image, like the image of yourself you see when you look in an ordinary mirror—your reflection appears to be a person standing behind the mirror.

The same kind of optical system sits atop the Philco portable. It has a concave mirror to magnify the face of the picture tube. To see this magnified picture, your eyes focus on a point four feet behind the TV set. So the image you watch is large, and appears to be hanging in space behind the set.

And that's the secret. It means:

 You can use a very small picture tube—two-inch screen—with great savings in cost, bulk and weight.

A small tube gets by on less electricity, so you save on batteries. The reason is that much of the power goes to swing the electron beam back and forth.
 A small tube can be built with a narrow

swing (30 degrees instead of 110) without becoming impossibly long.

 Bright sunlight can't wash out the picture because you don't look at the tube face directly. The image you focus on is four feet behind the case, so you can stick your head right up under the little visor and watch in comfort.

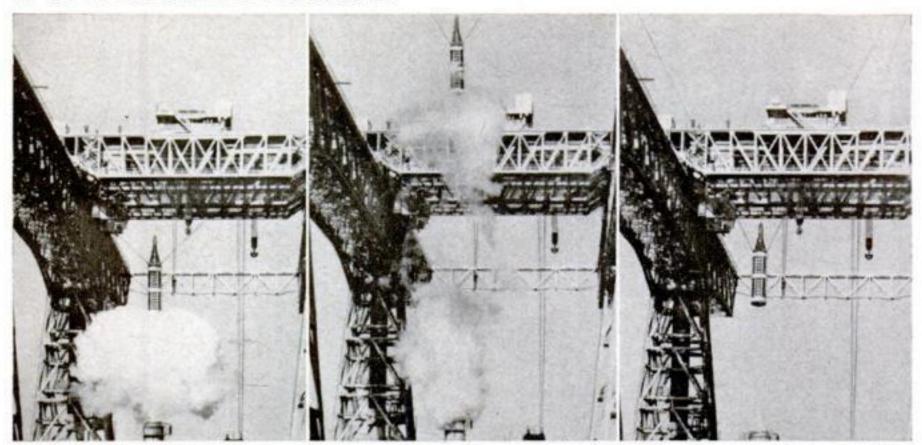
Naturally, you don't get all this for nothing. The small tube has to be carefully made, precisely positioned and protected against dust. Otherwise, any defect will be magnified along with the picture.

More important, to see the picture at all you have to sit close to the set and squarely in front of it. If you move off the center line, the image slews out of sight. And this means just one person can watch. Two people can see only if they are on very, very friendly terms.

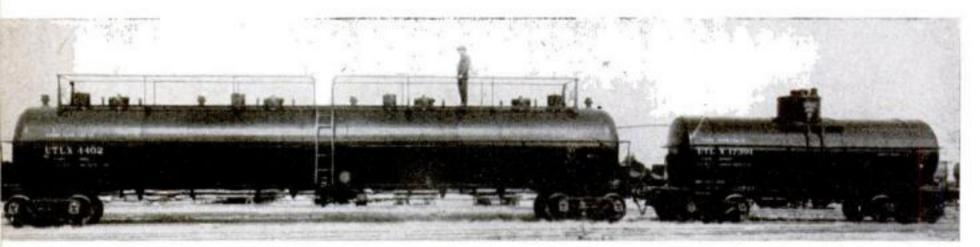
How good is it? Philco's engineers were ordered to produce a genuine portable. It

[Continued on page 192]

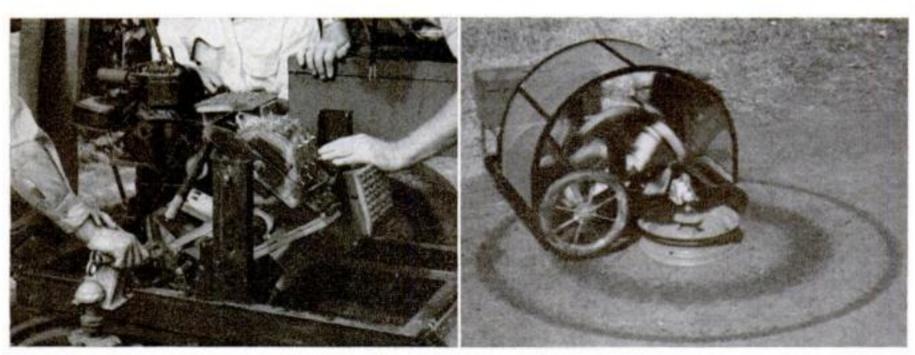
PS Picture News



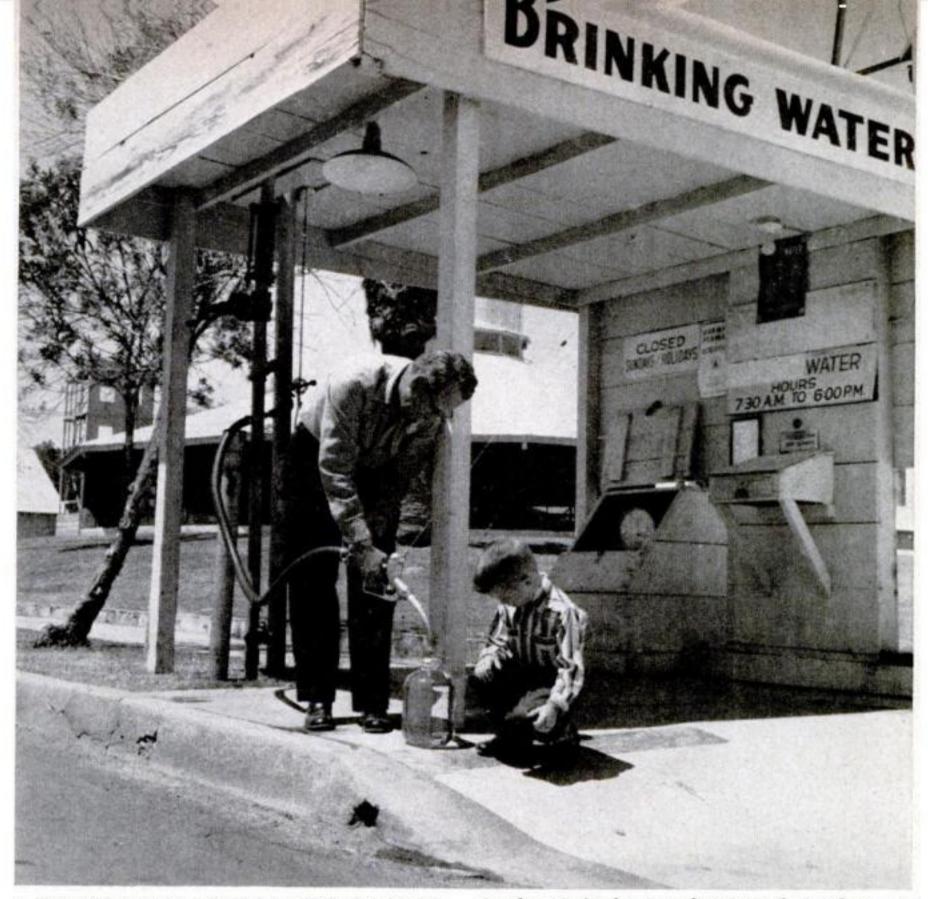
SKY CATCH. Here's the newest wrinkle in launching the Navy's Polaris. The sequence photos above show a dummy missile blasting off, being snubbed by a carrier arresting gear, finally lowered back down after the catch. The operation makes retrieving easy, permits study of launching stresses.



TANK WHOPPER. This huge tank car is 67½ feet long, 14½ feet high. It holds 21,800 gallons in four 5,450-gallon sections, dwarfs a standard 8,000-gallon car (right). It was built by Union Tank Car Co. to carry lubricating oils from Pennzoil refineries to storage and distributors.



TURF TRAMPER. Revolving feet and spiked rollers on this machine spend their time scuffing lawns. The gadget was developed by a UCLA professor to test wearability of various grasses. The wheel riding at an angle (right) was designed to simulate a golf cart under severe conditions.



A NEW KIND OF FILLING STATION caters to people who live beyond Coalinga's water pipelines.

At the city's demineralization plant, they can load up for a cent and a half a gallon.

This Town Drinks 'Undrinkable' Water

Coalinga, Cal., has found a way to wet its whistle with water from brackish wells

A LITTLE city on the western edge of the great, central San Joaquin Valley of California is gurgling its way into history.

Coalinga is the first city in the U. S. to draw all its drinking water from a vast underground source—one no American city has relied upon before. The water gushes to the surface from wells as deep as a quarter of a mile below this prosperous oil-and-farming community of 6,500 people. It's naturally undrinkable. Before treatment, it tastes as if brass had been stored in it, is disagreeably laxative and so hard that it curdles shaving-cream lather to the consistency of cottage cheese.

The town now runs this clear but repellent liquid through a series of electrified filters. These remove more than 85 percent of its high mineral content. After that, it tastes delicious and is soft enough to suit the most finicky laun-

UNTREATED Brackish Water DRINKING WATER animinaniming The

WATER FOR ALL NEEDS. After 60 years of hauling in drinking water by railroad, town now produces more than it requires. Surplus is stored in 75,000-gallon tank in foreground.

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Untreated, Coalinga's water is

dress. The city demineralizes 28,000 gallons a day, drinking 17,000 of them and storing the rest in an elevated, 75,000-gallon tank.

The underground water supply in this isolated part of California, 50 miles southwest of Fresno, is brackish. It contains a far larger proportion of dissolved minerals than fresh water does, though much smaller than that of salt water. Veins of brackish water, sometimes hundreds of feet thick, run for hundreds of miles under land that receives very little rainfall. Next to the oceans, these veins are the most plentiful source of water in the world. Yet, until lately, when the steadily falling fresh-water table began to cause serious concern, no one gave much thought to making such brackish water drinkable.

Coalinga was a logical community to try first. If it had to depend on rainfall, it couldn't exist. Water to irrigate the enormous fields of barley, oats, alfalfa and cotton has been pumped from deep, brackish wells. Since 1926, Coalinga has drawn upon its own bitter wells to sprinkle lawns and flower beds, wash cars, flush toilets and fight fires. But for 60 years, until last March, all its drinking water arrived in railroad tank cars, which hauled it 45 miles.

Imported water was at first emptied into a cistern beside the tracks and pumped out by hand. Later, it was carried throughout the town by water carts to 80-gallon storage tanks in people's front yards. In 1926, two tall, central storage tanks were erected, one for drinking water, the other to hold brackish water for less-exacting domestic uses. Each tank was provided with its own pipeline network to the town. The existence of a separate, metered distribution system for drinking water made it less costly to switch from tank cars to a demineralization plant last March.

The electric-membrane equipment that now makes the city's undrinkable water drinkable is built by Ionics, Inc., of Cambridge, Mass. Similar apparatus is in use on Texas Towers in the Atlantic, at a U. S. radar base in Montana, and at a few oil-producing stations in the Middle East.

Its functioning depends on the fact that salts and minerals in solution break

brassy, laxative, and so hard it curdles shaving cream

down into invisible particles with positive or negative electric charges. These charged particles are called ions. When a mineralized solution is placed in a container between positive and negative electrodes, a direct current is passed through it. Positively charged ions tend to move toward the negative electrode, negative ions toward the positive electrode.

The basic unit of the Ionics equipment is a stack of 300 thin sheets, or membranes, of ion-exchange resin. They are separated by 300 spacers with intricate channels cut in them for water to follow. Membranes and spacers are 18 by 20 inches in area, each only a few thousandths of an inch thick. Altogether, they make a pile two feet high, clamped between steel plates containing electrodes.

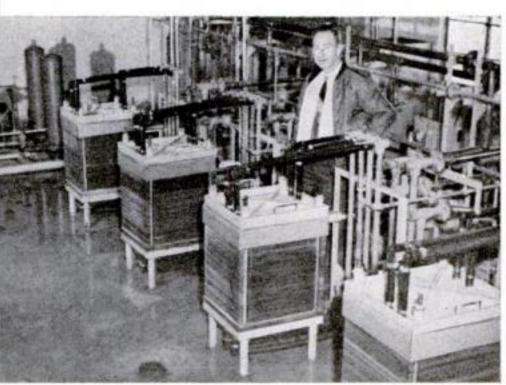
Brackish water is piped to and from the stack in two separate streams, circulating through alternate spacers. Water can't penetrate the membranes, but ions can.

When the electrical current is turned on, half the membranes allow positively charged ions from the water, such as so-dium, calcium, sulphur and magnesium, to pass through them. Alternate membranes permit only negatively charged ions to get by. As a consequence, one stream of water constantly loses part of its mineral content, while the other stream gains some.

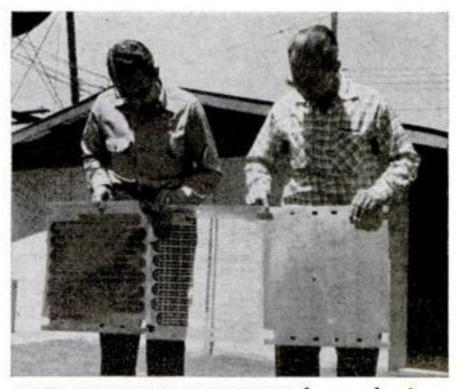
The greater the concentration of minerals in the water, the more stacks are needed to make it drinkable. Coalinga uses four, looking like a row of beehives.

The entire demineralization plant doesn't take up much more space than a large living room. Brackish water, at the rate of 30 gallons a minute, is pumped through each stack in turn. The stream being sweetened for the city to drink-20 gallons a minute of the total flow loses about 40 percent of its remaining minerals in each stack. The rest of the water is called the waste stream, but not much of it is wasted. Seven gallons a minute are routed into one or the other of Coalinga's two small, roofed reservoirs. for any use but drinking and cooking. Only three gallons a minute go into the sewer. They contain not only concentrated minerals but an acid solution that cleans mineral accumulations off the membranes in the stacks.

Though three or four citizens thought at first that they detected an unpleasant change in the taste of their drinking water when Coalinga changed over from tank cars to electric membranes, most members of the community seem satisfied. One aspect of the change pleases them very much. Drinking water hauled in on the railroad used to cost \$7.50 per 1,000 gallons. Coalinga now produces its own for around 80 cents per 1,000 gallons. And once the new plant is paid for, residents can look forward to a generous cut in the cost of wetting their whistles. —Wesley S. Griswold.



BITTER WATER IS MADE SWEET at Coalinga by being pumped through these four stacks of electric membranes, uncovered for the photo by R. O. Phelps, Superintendent of Public Works.



THESE ARE SAMPLE MEMBRANES from a demineralizing stack, with a spacer between them. The darker membrane lets only negative ions get by; the other one passes only positive ions.

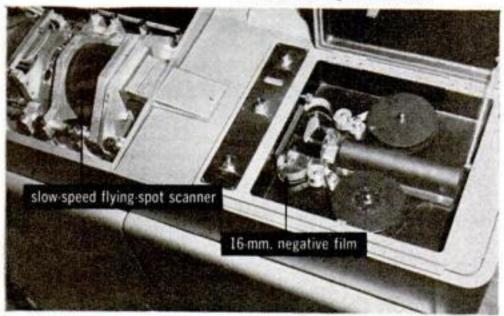
TV Crosses Atlantic By Going Slow

How it's done:

1 Movies of scene are rushed to studio for fast processing



2 16-mm. negative film is passed through film-scanning console below

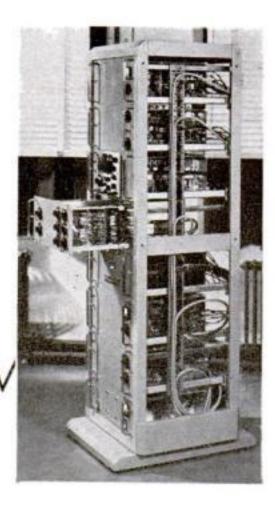


3 Electron beam scans 200 horizontal lines across every other frame of film, taking 8 seconds to complete each frame

A Flectrical signal from scanner

4 Electrical signal from scanner, corresponding to light and dark of picture, is impressed on carrier wave by modulator (right)

BIG SQUEEZE gets TV film pictures through transatlantic telephone cable. British Broadcasting engineers remove fine details from pietures to be sent by (1) limiting horizontal definition, (2) slicing each picture into 200 horizontal lines instead of the 405 standard in British TV and (3) skipping every other picture completely. This still leaves 100 times more information per second than phone cable can handle. So they slow down the actual transmission 100 times, taking 100 minutes to send one minute's worth of film. Time is speeded up again to normal at receiving end, but detail cannot be restored and pictures are coarse and contrasty, as actual photo (at right) of the TV image received in the U. S. shows.





Modulated carrier wave enters transatlantic telephone cable in Scotland

OU can watch Europe on your TV set now, thanks to clever electronic and optical trickery that gets the and optical trickery that gets the the set of the flown across the Atlantic for telecasting (best time: eight hours).

This is Europe-to-America TV direct.

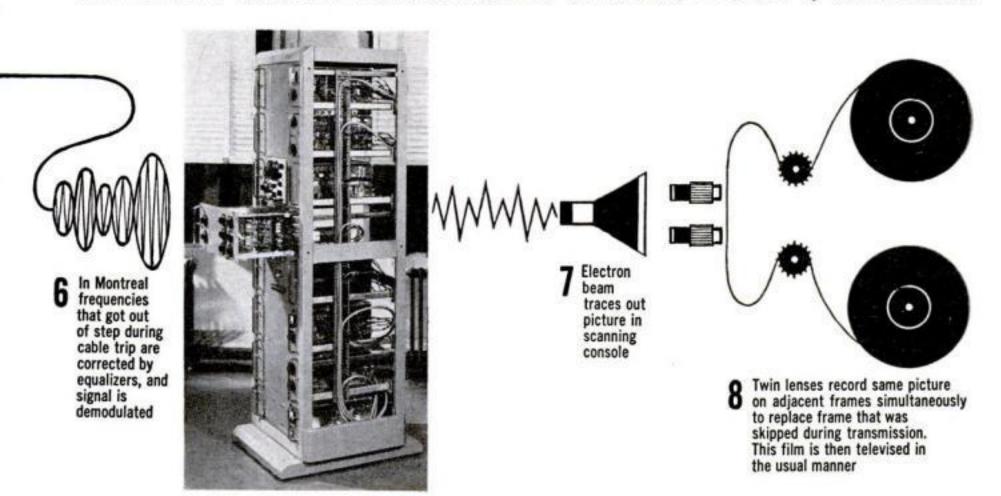
Transatlantic telecasts began this summer in proper regal fashion with a shot of Queen Elizabeth boarding a Canadabound jet. The scene lasted two minutes—but required 2½ hours to transmit over the telephone cable. Previously movies had to

pictures across the ocean fast by slowing

This is Europe-to-America TV direct, but not live. Movies of the scene are rushed to British Broadcasting Corporation studios, processed, and then converted into electrical signals by a special TV scanning device. The signals cross the ocean to Montreal over the transatlantic telephone cable, are then converted back into light and put on movie film again. The regen-



First cabled TV looked like this. Photo was made off his home TV screen by PS' Bill Morris.



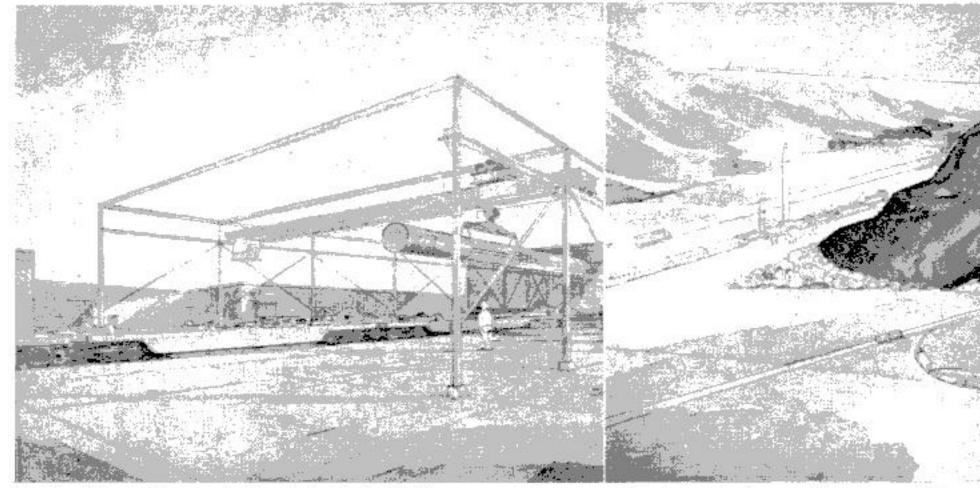
erated film is transmitted from Montreal to the rest of Canada and to the U. S. the same way ordinary TV movies are.

The system for cabling movies (see sketches) is similar to the one that newspapers use to transmit still photos by telephone.

The hard part is getting the pictures over the telephone cable — movies carry some 4,000,000 "bits" of information per second, while the cable has room for only

1,500 bits per second. The secret is to slow down the movies and reduce the information content electronically.

Live TV (50,000,000 or more bits of information per second) still can't squeeze into the narrow pathway of a telephone line. That kind of a show will have to wait high-orbiting communications satellites (PS April), which can bounce information-loaded radio beams across the ocean. One should be in orbit in a year or so.



Railroad missile car is loaded at right-of-way warehouse.

Underground roundhouse could

Could Rail-Riding Missiles Avert Surprise Attack?

U. S. experts propose new strategy—firing missiles from railway cars—to solve problem of sitting-duck rocket bases

POR almost two years—ever since Russia's Sputnik I soared into orbit—the U. S. has been worrying about the possible destruction of its retaliatory missile bases by a surprise attack. These permanent sites for our own intercontinental ballistic missiles could theoretically be wiped out in a twinkling.

Now the Air Force believes it has come up with an answer—put the missile launching pads on railroad cars. Keep shunting them around the country, and so play hide-and-seek with an enemy as our missile-armed subs could do at sea.

Plans have been drawn for manufacturing perhaps as many as 200 missile railroad launcher-trains. They would travel camouflaged over the 389,000 miles of railway trackage in the U. S., lost to hostile missiles among each day's 15,000 freight train movements. Some trains would be

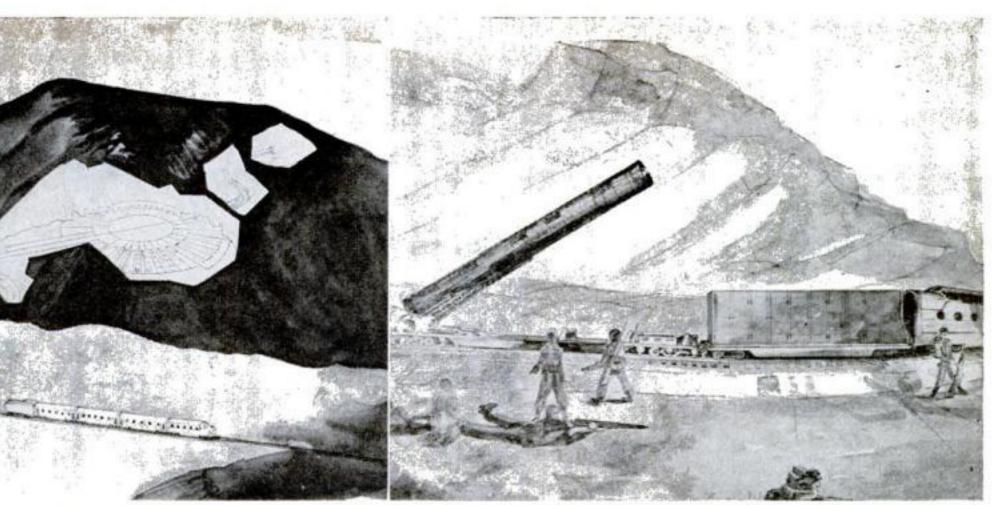
on the go constantly. Some could be dispersed at sidings, in mines, tunnels, and warehouses. The trains could launch scores of ICBMs toward enemy targets within minutes of notification.

The missile trains are designed to fire the Minuteman, a solid-fuel, 55-foot weapon to be operational in 1962.

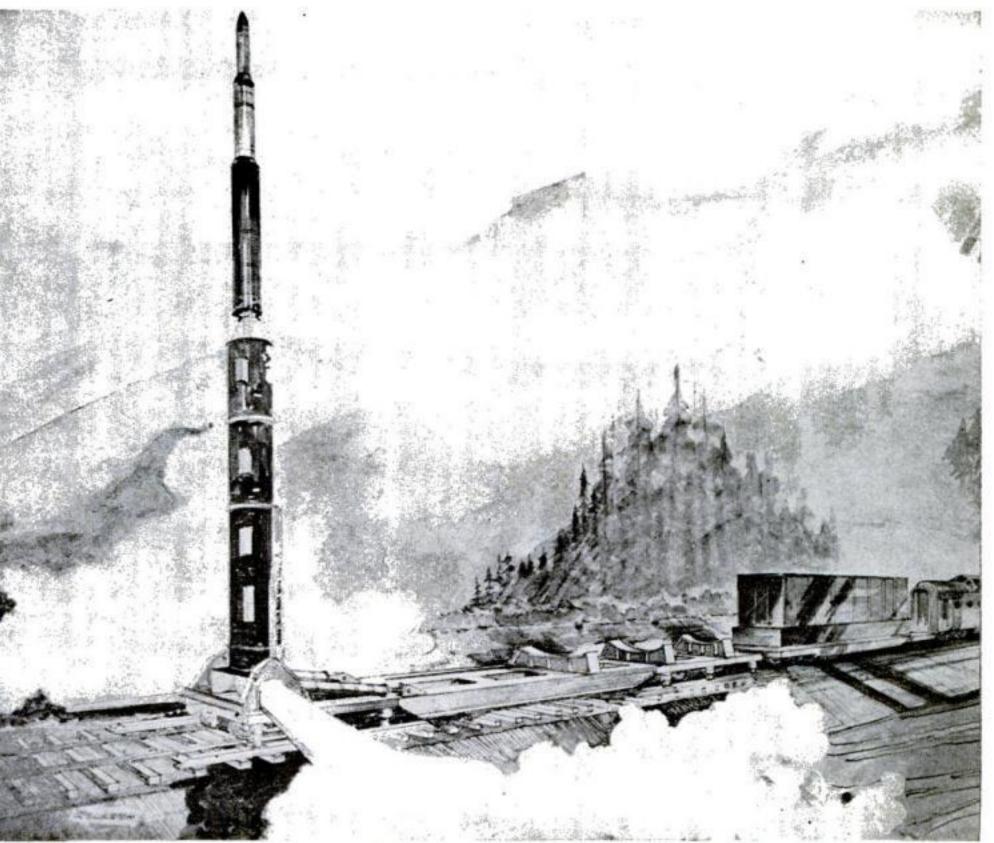
A President's Committee has made a further recommendation—that such trains be manufactured for nations in the North Atlantic Treaty Organization. These would ride the Western Europe rail network carrying the Polaris missile.

As yet, no green light has been given a manufacturer. What the mobile missile launchers might look like is shown in the accompanying artist's conceptions of designs that have been drawn jointly by Paul Hardeman, Inc., of Los Angeles, and the Bethlehem Steel Co.

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be used to conceal launcher cars. Power rams raise steel-capsuled missile to firing position.

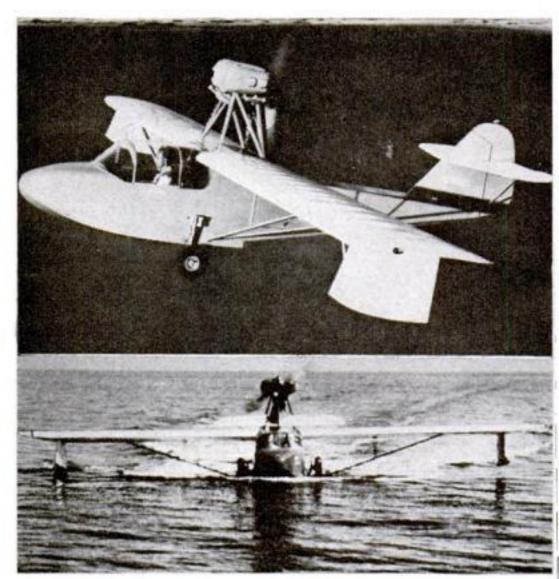


Missile is fired directly out of the capsule. Steel shields deflect flames from the launcher.

PS Picture News



HIGH RIDER. The tractor on stilts shown above in a gooseberry field in Kent, England, is a conversion from a standard tractor. It's made for harrowing between rows of crops up to $4\frac{1}{2}$ feet tall. Wheels can be set five, six or seven feet apart.

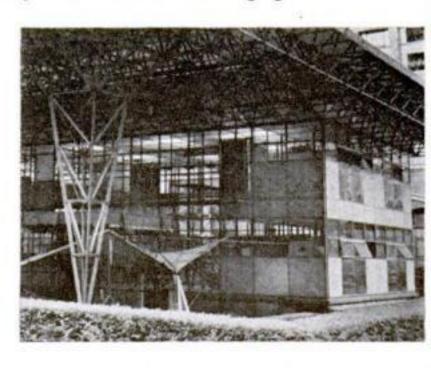


BABY AMPHIBIAN. This new light plane carries two people, and has a range of 350 miles. Its 85-hp. pusher engine gives a cruising speed of 80 m.p.h. Built by Jensen Aircraft, Glendale, Cal., it has manually retractable landing gear.



BOLTED HOUSE.

A prefabricated twostory building (right) on the University of Michigan campus was put up with wrenches. Its paneled interior (left) can be altered quickly, worn parts can be discarded and replaced, or the entire structure can be dismantled, moved and reassembled easily.





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swinging arms of the big sprinkler at left irrigate an acre of California grain land in one setting. The 70-foot nozzle booms can be lowered for moving under power lines to other parts of the field. When spraying, they rotate like a lawn sprinkler.

"I'd like to see them make..."



OVERHEAD TOWLINES for use on bridges and in tunnels. A stalled car could be hooked to the line and pulled out of the way fast.—Alexander Morris, Mahopac, N.Y.



A TOOTHBRUSH on a flexible cable that could be attached to an electric razor. It would clean your teeth with a rotary motion.—W. R. Bottger, Oklahoma City.



A BACK PACK FOR OUTBOARD MOTORS. Clamped to a board mounted on the pack, the awkward motor could be carried with greater ease.—
R. M. Woodbury, Natick, Mass.



A TRANSPARENT MAILBOX. With a clear plastic box you could see if mail had been delivered. The box wouldn't rust or require painting.—
Rick Megenity, Seattle.



A POWDERED-SOAP DISPENSER you could re-use on each new carton. Like a jigger dispenser for liquor bottles, it would pour out a measured amount.—Carl Hirschfeld, Los Angeles.

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What's

yours? We will pay \$5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.

Here's where your auto dollar goes. Some items you can't change, but—

How Much Do You Actually

Save With a Small Car?



INSURANCE



REPAIRS

By Harry Walton, author of Popular Science Standard Guide to Economy Cars

"THY drive that little beetle just to save 50 bucks a year on gas?" asks the big-car fan.

"It's 50 dollars in my pocket," retorts the economy-car owner. "And I save still more in other ways."

What's the straight dope on small-car "economy"? To find out, I interviewed:

- A prominent firm of fleet-cost engineering consultants.
- A commuter using two cars, one of them a Fiat 600.
- Long-distance movers, whose estimators drive Renault Dauphines.
- A manufacturer whose salesmen use Kharmann-Ghia Volkswagens.
- A Hillman owner with a complete expense record for 100,000 miles.
- A small-city cab company operating Fiat 1100 sedans.

Their answers show that you can save with a small car on some important items.

Car expenses break down into two main groups—fixed costs that stand pat whether you drive 2,000 miles or 20,000 (insurance, license and depreciation); and variable costs that depend on the mileage driven (gas, oil, tires, lubrication, adjustments and repairs).

You probably won't save on insurance by buying a small car. Liability insurance costs the same as for a big one. Fire and theft coverage is priced on value—and a new small car may be worth more than an older large one. You'll probably pay more for collision insurance—the lower-priced \$100 deductible may do for a depreciated automobile, but fuller coverage is generally preferred on any new, largely unpaid-for one.

You do get a break on license costs in some states, thanks to the economy car's lesser weight and lower engine rating. In one case where both city and state licenses are required, fees for a Ford V-8 come to \$49. Licensing a Peugeot in the same area costs only \$21.50. A two-car salesman pays \$17 less each year to buy a New York plate for his tiny Renault 4CV than for his Cadillac.

Depreciation is a hard nut to crack with any car except the Volkswagen, which drops a few hundred dollars the first year. Among other imports, first-year depreciation runs from under \$400 on a Fiat 600, Hillman or Renault to over \$600 on a Peugeot and \$700 on a Borgward. On the popular smaller cars the average is 25 percent, whereas first-year depreciation on the American Big Three may be, some accountants say, as much as 39

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DEPRECIATION

INTEREST ON LOAN

LICENSES







OIL AND LUBRICATION

TIRES

GASOLINE

How engineers compare costs of a V-8 and an economy six

Below are car-cost allowances for employees driving their own cars on company business, as computed by Runzheimer and Company, Inc., Chicago consulting engineers, who have been studying national fleet costs for 25 years.

These figures, for automobiles operating in metropolitan Chicago, are based on a yearly average of 10,000 miles. Both cars have automatic transmission, heater, radio and other standard accessories.

Operating in metropolitan area where 50 percent of driving is "stop and go"	1959 FORD FAIRLANE V-8 two-door sedan	1959 RAMBLER AMERICAN SIX two-door sedan
Standard miles per gallon	13.5	18.0
Normal gas price in operating area: (per gal.)	33.0¢	33.0¢
Gasoline and oil: (per mile)	2.58∉	1.93∉
Maintenance: (per mile)	.70¢	.70¢
Tire repair and replacement: (per mile)	.47¢	.37¢
TOTAL VARIABLE COSTS: (per mile)	: 3.75¢	3.00¢
Fire and theft Insurance:	\$23.00	\$18.00
Liability insurance:	150.60 150.60 49.00 23.50	
City and state licenses:		
Yearly depreciation (2½ year trade-in)	682.00	538.00
Interest (on 75 percent of car price)	66.90	56.75
TOTAL YEARLY FIXED COSTS:	\$971.50	\$786.85
Fixed costs per mile (10,000 miles yearly)	9.71¢	7.87¢
TOTAL ALL COSTS: (per mile)	13.46¢	10.87¢

Gas mileage and maintenance are based on actual fleet records. Insurance and license costs are for the Chicago metropolitan area. Runzheimer and Company base the depreciation figures on their recommended practice of trading a car at the end of 30 months or 45,000 miles, whichever occurs first. For

private use, a four-year trade is more economical and will reduce the annual depreciation by about \$175.

Interest costs assume you would need a loan of 75 per cent of the purchase price at five percent, and are averaged out over the 2½-year period (interest falls off as payments on the principal add up).

Case-history cost for two popular economy cars

The figures at right are based on actual operating records of the Weeks Moving and Storage Corporation (Dauphines) and Frederick Lockwood (Peugeot). The Dauphines are driven in a metropolitan suburban area, and the gas mileage shown is a low fleet average. That for the Peugeot has been revised downward to approximate the same kind of driving. For comparison, gas, license and insurance costs shown are for the Chicago area, and depreciation is figured on a 30-month trade-in. The Peugeot maintenance figure includes .526 cents per mile for actual repairs to date. plus an estimated .32 cents per mile for tires.



	RENAULT DAUPHINE	PEUGEOT 403
Miles per gallon	33.4	28.0
Normal gas price (per gallon)	33.0¢	33.0≰
Gasoline and oil: (per mile)	1.098∉	1.20∉
Maintenance and tires: (per mile)	1.23¢	.846¢
TOTAL VARIABLE COSTS: (per mile)	2.328∉	2.046¢
Fire and theft insurance:	\$14.00	\$18.00
Liability insurance:	150.60	150.60
City and state licenses:	21.50	21.50
Annual depreciation:	375.00	450.00
Interest:	41.13	56.75
TOTAL YEARLY FIXED COSTS:	\$602.23 \$696.85	
Fixed costs per mile (10,000 miles annually)	6.022¢ 6.968¢	
TOTAL ALL COSTS (per mile)	8.35¢	9.01∉

percent, or \$1,049 on a Ford, Chevrolet or Plymouth delivering at under \$2,700.

If, like most private owners, you keep the car four years, you can average out depreciation on a Big-Three V-8 to about \$430 a year. On a lower-priced import it should be considerably less, though with new American-made small cars coming, it is impossible to forecast what even the redoubtable VW will be worth four years from now.



FOUR FIAT TAXIS like this average 25 to 30 miles per gallon in stop-and-go driving, the operators report. Clutch repairs were needed and tires recapped at about 30,000 miles.

Depreciation, like taxes, will always be with us. But the economy car does smooth some rough edges off it.

Small one-time savings show up in price. Freight and preparation charges for an economy car are somewhat more modest than on big cars. Many, though not all imports, include a heater as standard equipment. A few even throw in white sidewall tires.

On lower-priced models you naturally pay less Federal and sales tax, and smaller interest charges. But these savings dwindle as you climb the price scale. On the four-cylinder "compact" cars you could pay as much as on a sixcylinder domestic model.

The gas economy of the small car is generally conceded even by die-hards in the big-car camp. Small four-passenger sedans deliver up to 40 miles per gallon. Some of the bigger "compact" fours get only 22 in overall highway and city driving. But compare this with the 13.5 miles that Runzheimer and Company, Inc., fleet-managing consultants to many carusing companies, find average for a 1959

A 100,000-mile cost record on a Hillman Minx

In 1953 Malcolm Miller, of Knoxville, Tenn., bought a new Hillman and proceeded to drive it for 100,000 miles, far beyond the point at which experts advise trading. At right is his record of what he spent on the car.

The original English tires were recapped at 60,000 miles, discarded at from 76,000 to 97,000 miles. Tire costs shown include puncture repairs, recapping, and the cost of new replacements.

Maintenance and repair costs include needed body work, a complete paint job, washing and polishing. The yearly depreciation shown is based on a 76.1 percent loss over five years. Interest, not shown in the owner's record, is an assumed average over the five-year period.

	Actual cost	Per mile	
Mechanical work	\$ 695.22		
Body work	128.56		
Lubrication	105.44	•	
TOTAL MAINTENANCE	\$ 929.22	.929¢	
Gasoline 4,211 gallons	\$1,192.96*		
Engine oil 348 quarts	160.33		
TOTAL GAS AND OIL	\$1,353.29	: 1.353¢	
All tire costs	171.13	.171∉	
TOTAL VARIABLE COSTS	\$2,453.64	or 2.453¢ per mile	
	1800 880	A 15 14	
All insurance, annually:		\$136.57	
City and state license, annually:		21.73	
Depreciation (annually, over five years):		280.00	
Interest (averaged over five years):		26.25	
TOTAL FIXED COSTS:		\$464.55	
Fixed costs per mile, at 20,000 miles annually:		2.322¢	
TOTAL OF ALL COSTS PER MILE:		4.775¢	

Ford V-8 in heavy-traffic city driving. As you would expect, our domestic six-cylinder cars lie between the V-8s and the four-cylinder imports in economy. Runzheimer fleet studies credit the Rambler American six with 18 miles per gallon in metropolitan traffic.

A commuter who covers 24 miles to and from his railroad station daily, and whose wife travels even farther on family errands, used 781 gallons of gas in a 1957 Chevrolet and a 1940 Pontiac over a 12-month period. Keeping the Chevy, he replaced the Pontiac with a Fiat 600. In the following 12 months he used 614 gallons, a saving of 167 gallons, or \$50 at 30 cents per gallon.

The insurance agent, who saves his Cadillac for long hauls, does about 250 miles of stop-and-go driving weekly in his 4CV on two dollars worth of gas. His big car burned eight dollars worth for the same mileage.

Getting down to business. A division manager of Otarion Listener Corporation of Ossining, N. Y., makers of hearing aids, was paid seven cents per mile for using his own big car in California. In a 9½-month period he received \$672 for 9,607 miles of travel, an amount he found did not cover his operating costs and depreciation.

The company bought a Kharmann Ghia for his use. In the same period for 1958 he drove it 12,146 miles, spending \$138 for gas, \$58 for servicing, oil and repairs, and \$21 for storing, parking and cleaning the car. This comes to under 2.3 cents per mile, to which must be added depreciation, insurance and license costs. But the saving was dramatic.

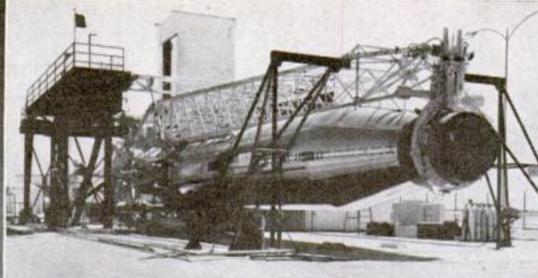
In Rockville Centre, N. Y., the Weeks Moving and Storage Corporation provides its estimators with Renault Dauphines. Records of three of these show that one delivered only 30.7, another 33.4 and the third 40 miles per gallon. Despite this variation, all show substantial savings over cars previously used.

You'll save at the gas pump with an economy model, but the big difference shows up only if you cover lots of miles. The 3,500 mile-a-year owner may pocket

[Continued on page 212]

PS Picture News





FAST LAUNCHER.

Here's how the Atlas, shown being erected at left, will be put into the air in a hurry at SAC operational bases. Instead of being held on gantries, as at test bases. the ICBM rocket will be stored horizontally (top), raised to firing position (right) minutes after the press of a button. It will move from assembly plants on the new carrier below, backed into and strapped on the launcher.



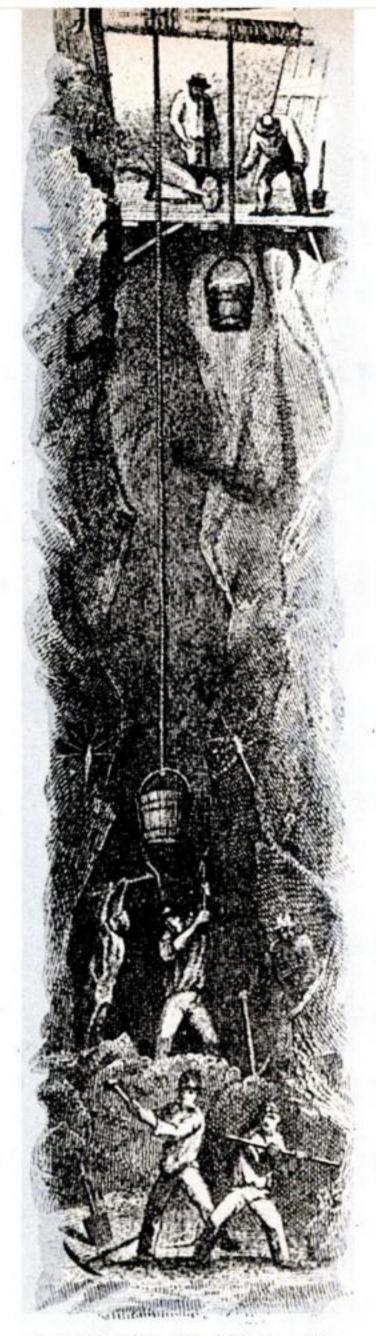




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BIG AIR TERMINAL.

Miami's new air terminal building, said to be the world's largest under one roof, will be opened this winter at its 2,878-acre International Airport. The building, designed in the shape of a huge arc (left), is 3,000 feet long, cost \$21,000,000 to construct. An adjacent parking area will handle 5,000 cars. Planes, including jets, have runways up to 9,400 feet with room for expansion to 11,200 feet.



"rock oil" Drake's backers meant to exploit that their 1855 stock certificates bore this conception of the work. The engraving illustrated the company's intention to "bore, dig or mine" for the petroleum.

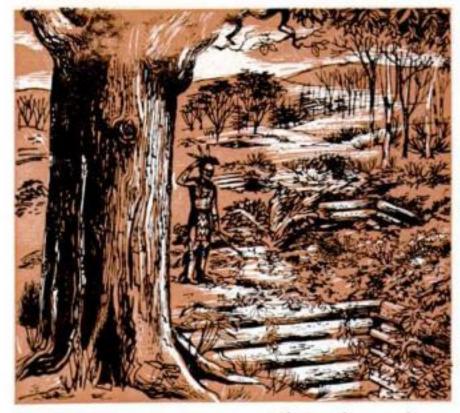
Just 100 years ago—hard work, ingenuity, and some pretty weird machinery set off The Great American

HIS month the oil industry celebrates its centennial. Just 100 years ago the first commercial oil well was brought in near Titusville, Pa. In that backwoods village in August, 1859, began a boom that was to afford men the greatest opportunity of the century—perhaps of all time—to strike it rich.

Pennsylvania's '59ers did not even have to travel far. The oil country was on the very doorstep of the populous East. Drilling rights were obtainable for a few dollars and a share in the prospective oil. Wells could be sunk with

THE WELL THAT STARTED IT. In this photo taken by John Mather in 1861, Edwin L. Drake (with beard) stands near the well he brought in in 1859. Though never itself a big producer, it sparked the great oil boom.

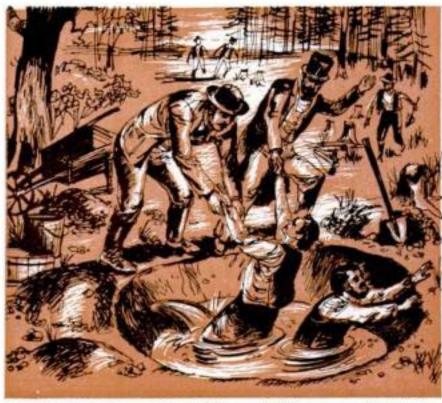




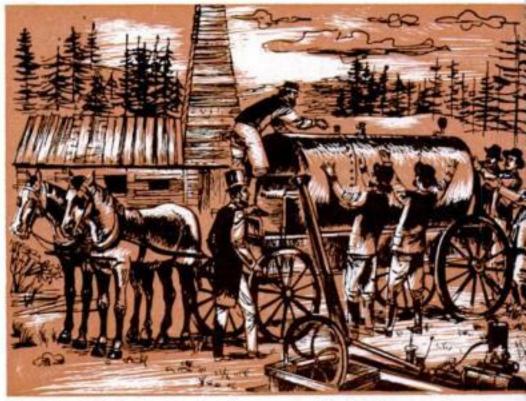
MYSTERIOUS OIL PITS near Oil Creek may have been the work of a race preceding the Indians. Roots of 300-year-old trees running through some of the 2,000 pits testify to their age. Log cribbing is half-lapped at the joints, a construction Indians did not use. The oil seeped up inside the pits to form storage pools.



ROCK OIL PUMPED UP by salt wells was considered a nuisance and dumped in a nearby canal. One day in 1845, a boy threw a torch into the water. The oily surface burst into flame for hundreds of feet. The incident furnished dramatic proof that the despised stuff was good for something: It would burn with enthusiasm.



TIGER BY THE TAIL. When Silliman called the oil a valuable raw material, a company formed to exploit it sent Edwin L. Drake to Titusville. Finding the land a pool from which only a few gallons a day could be skimmed, he had a well dug to tap a more generous supply. But inrushing water almost drowned the diggers.

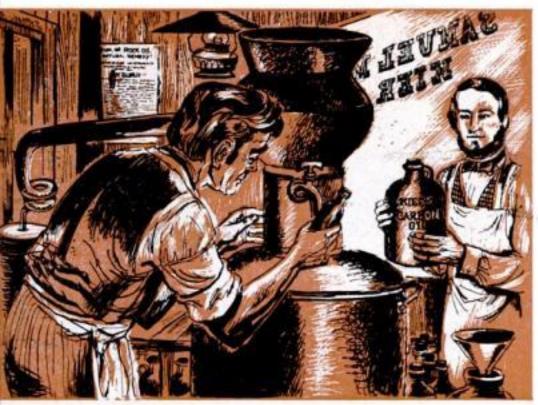


the rudiments of cable drilling. Told by his backers to abandon work, Drake used his own credit to buy a "Long John" steamboat-type boiler and a six-hp. engine. His derrick was made of four 30-foot poles, set 12 feet apart at the bottom and three feet apart at the top.

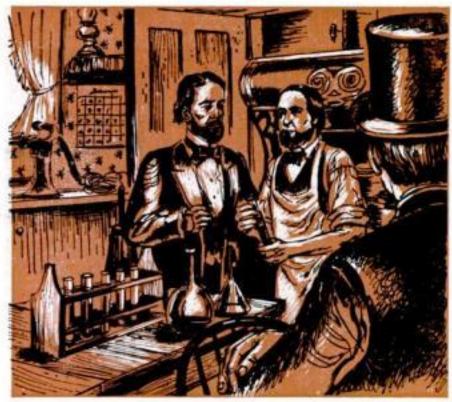
primitive tools and muscle power. Millionaires were made by sweat, persistence and a modicum of luck.

The sticky, bluish-green gunk from the earth was to prove more potent than gold. From a mere spark in the newfangled kerosene lamp (which ran the great whaling ships off the map), oil was to become the life blood of the horseless carriage, the wing beat of the Wright Brothers' original flying machine, the sinews of motorized warfare and the power of today's jet-age planes.

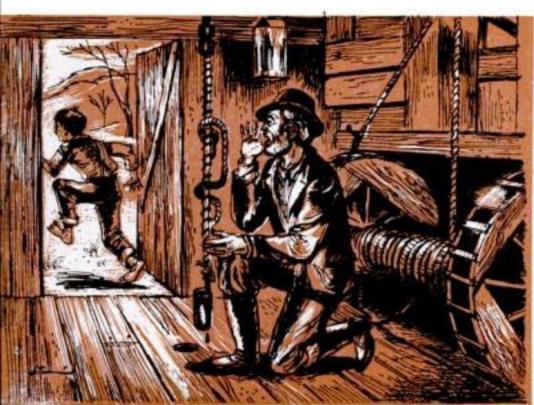
Crude oil was known to the ancient Chinese and in the Near East. In this country, the Indians used it as a medicine. But there is evidence than an even earlier race, the mound builders of the



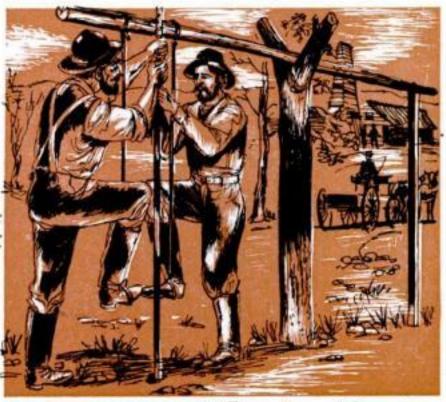
paleface medicine man, Samuel M. Kier bottled the black gunk from his father's salt well as a remedy for man and beast. Sensing its value as a lamp fuel, he set up a one-barrel still in Pittsburgh in 1851. So popular was his pale yellow "carbon oil" that he soon enlarged the still to make it a five-barrel producer.



OIL TOOK A GIANT STEP AHEAD when Dr. Francis Brewer took a sample from his father's farm to Dartmouth University. Young George Bissel saw it and in 1854 engaged Prof. Benjamin Silliman Jr., of Yale, to analyze and evaluate it. In a kitchen lab, Silliman broke down the crude petroleum into its various fractions.



THE FIRST USE OF CASING occurred when water flooded the wooden conductor pipe in which the drill worked. Drake then thought of driving cast-iron pipe to the first rock layer 32 feet down. On Saturday, August 27th, the drill stopped at 69 feet. Sunday morning, driller William Smith discovered that there was oil in the bore.



THE BOOM WAS ON. William Barnsdall, a shoe-maker, drilled on a relative's farm near Drake's well. Mounting a hickory pole on a post, he hung the drilling tool from the springy end and "kicked down" the well to a depth of 80 feet by jumping on stirrups. He brought in the first of the wells that followed Drake's success.

Mississippi Valley, collected it in pits dug for the purpose.

By 1807 white men were collecting it by the even more primitive method of the redskins—skimming it off pools and creeks, or soaking a cloth in the oil scum and wringing it out. Called Seneca or Genesee oil, the black stuff was sold as a cure for "rheumatick pains." A Pittsburgh man named Kier was farseeing enough to seek other uses for oil. He set up a still to refine it for lamp use, so becoming the first refiner. A cheap lamp oil was badly needed. So were lubricants for the multiplying wheels of the industrial revolution.

The first oil well was drilled by an ex-railroad conductor, Edwin L. Drake.

Deserted by his backers, he struck oil at the providentially modest depth of 69 feet. The boom was on as alert villagers staked out drill sites.

Many a man "kicked down" a well to riches with a drill tool suspended from a springy bough and driven up and down with his own leg muscles. Speculators, gamblers and land sharks poured into little Titusville. Teamsters and coopers amassed fortunes hauling oil and building barrels to hold it.

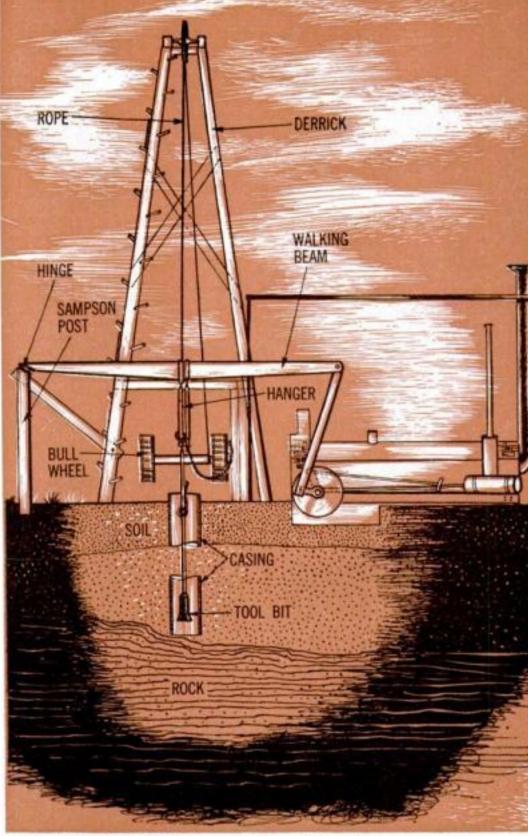
Gushers came in as wells were drilled deeper, to 400 feet or more. Some spouted three to four thousand barrels a day. Such overbundance almost brought disaster. In 1861 the price fell. It dropped to 20, 15 and even 10 cents per 40-gallon barrel.

Some freak wells flowed for so many minutes, stopped for a time, and then spouted again, all to a rigid schedule. But eventually gushers subsided and oil had to be pumped up.

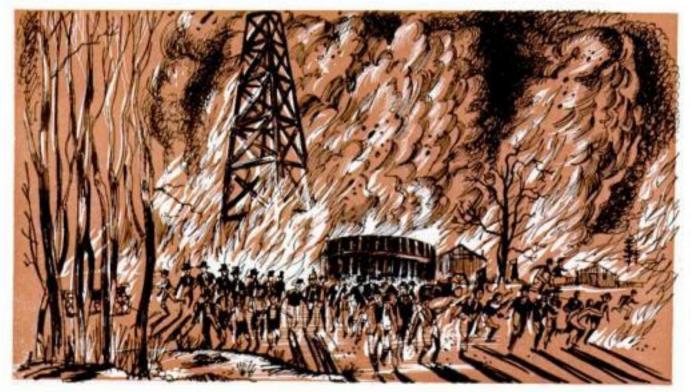
Torpedoing oil wells to restore their flow was the idea of a Union officer, Colonel E. A. L. Roberts. In 1865 he first exploded a gunpowder charge in a well. Later he learned to use nitroglycerin. The practice became common, spiced with patent fights, lawsuits, and picturesque "moonlighters" who torpedoed wells by night to avoid paying Roberts his royalties.

Lethally sensitive, nitroglycerin was brought to the well by horse and buggy, accompanied only by the shooter. Engaged in perhaps the loneliest work in the world, he poured the "shot" down the casing.

If all went well, he was rewarded with



for driving salt wells. A heavy chisel-edged tool bit lowered into the casing was raised and dropped by a walking beam linked to the engine shaft, pulverizing the rock. To remove water, mud and chips, the tool was hoisted out by a bull wheel and a sand pump or bailer lowered.



the Buchanan well, near what is now Rouseville. On an April evening in 1861, it began spouting a great column of oil. As a hundred people watched the marvel, fire in a nearby boiler ignited vapor-laden air. The gusher became a tower of flame. Even the ground burned. Nineteen men died.

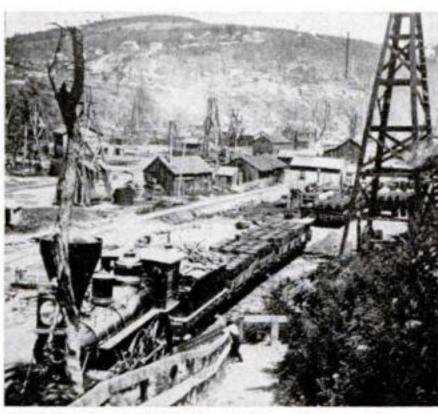
His camera caught oil boom's highlights



WHAT Mathew Brady did for the pictorial history of the Civil War, a young Englishman named John Mather did for the Pennsylvania oil rush. After learning from an itinerant photographer the new art of the camera—with its clumsy wet

plates—Mather heard of Drake's well and headed for it.

He stayed in the oil region all his life, following the big strikes from town to town. The photos in this article are from his files.



WHEN THE RAILROAD CAME, oil barrels were shipped as on this train photographed near Rouseville. Amos Densmore in 1865 devised the first tank cars, putting two round 45-barrel tanks on a flatcar. So profitable was the Oil Creek Railroad that it paid 25 percent in its first 14 months, as high as 53 percent later.

high pay and a three-day headache from nitro fumes. But mortality among shooters was high.

Pipelines came along as early as 1865, when bad roads, high teamster charges, and oil flowing faster than it could be taken away inspired an oil buyer to build one. Samuel Van Syckel laid five miles of two-inch pipe that moved 80 barrels of oil per hour. This first pipeline sparked not only others like it, but a long, bitter feud with teamsters.

Among all the fabulous gushers, no well created more wonder than one described by Hildegard Dolson in her book



OIL WENT TO MARKET by wagon, flatboat and river steamer, but most spectacularly on the spring freshet. Upstream dams were shut, oil loaded on whatever would float, and the water loosed to sweep all before it. In 1864 a boat lodged against a bridge pier at Oil City (above). The stupendous jam caused great loss.



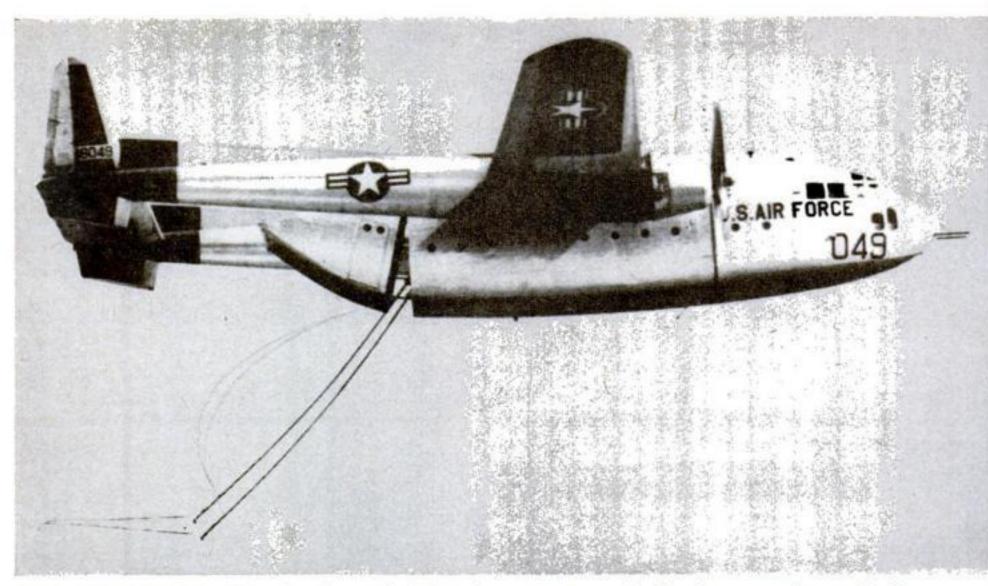
FIRE AND FLOOD engulfed Titusville in June, 1892, when a dam broke after heavy rains and a refinery caught fire. Storage tanks blew up. The burning creek carried the fire to Oil City, killing 125 persons. Mather took this photo of the disaster—a holocaust that would strike at him: In it, he lost 16,000 negatives.

The Great Oildorado. The driller of a hillside well, feeling the bit drop through the rock it was drilling, sent down the bailer. It brought up a foamy amber fluid like beer.

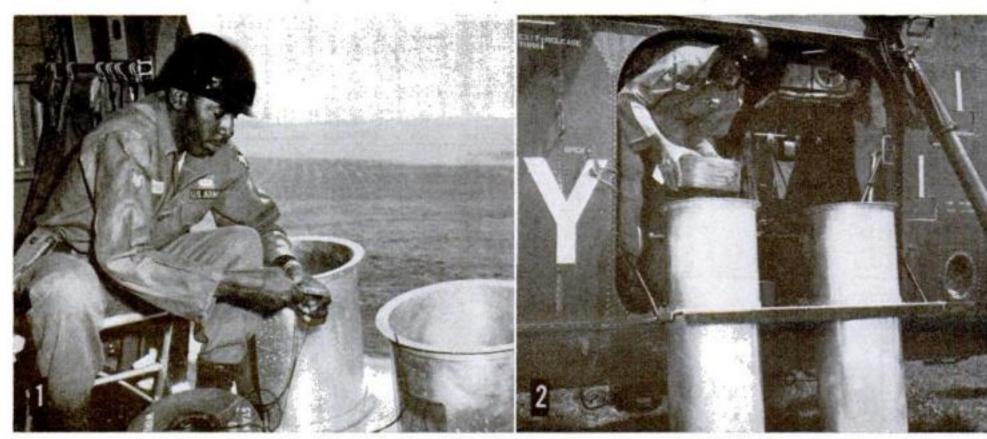
It smelled and even tasted like beer. Astounded visitors came to sample it and to toast the driller who had struck something better than oil. Last to come was a red-faced German.

"Gott im himmel!" he roared. "You haf broke into Grossman's vault!"

Grossman, a brewer, kept his product in a cave under the hill. The drill had broken into a tun of beer.—Harry Walton.

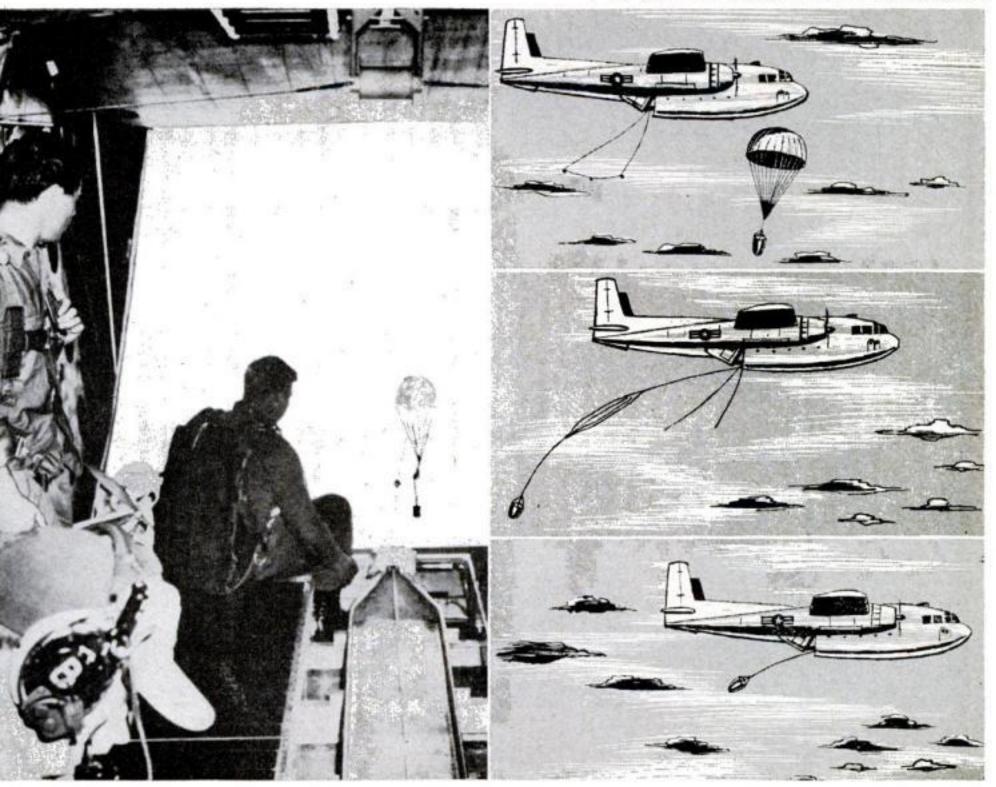


AIR SNATCH. Here's the Air Force's newest method of recovering missile capsules in flight. The Fairchild C-119 above was specially modified to handle the recovery gear, shown at right with a snared practice capsule being reeled in by winch. The drawings at far right show how the device works: With trapeze-like equipment let out through the cargo hatch, the plane overtakes and snatches a parachuted capsule and pulls it in. The equipment was designed for the recovery of capsules retro-rocketed from orbit on a re-entry trajectory, as part of the Discoverer program.



WIRE-LAYING COPTER. Twin dispensers on the side of this whirlybird make combat-communication wire laying swift and easy. Signalmen splice reels (1), load them in the dispensers (2), make ground connections (3) before takeoff, and fly with reels unwinding at 60 m.p.h.

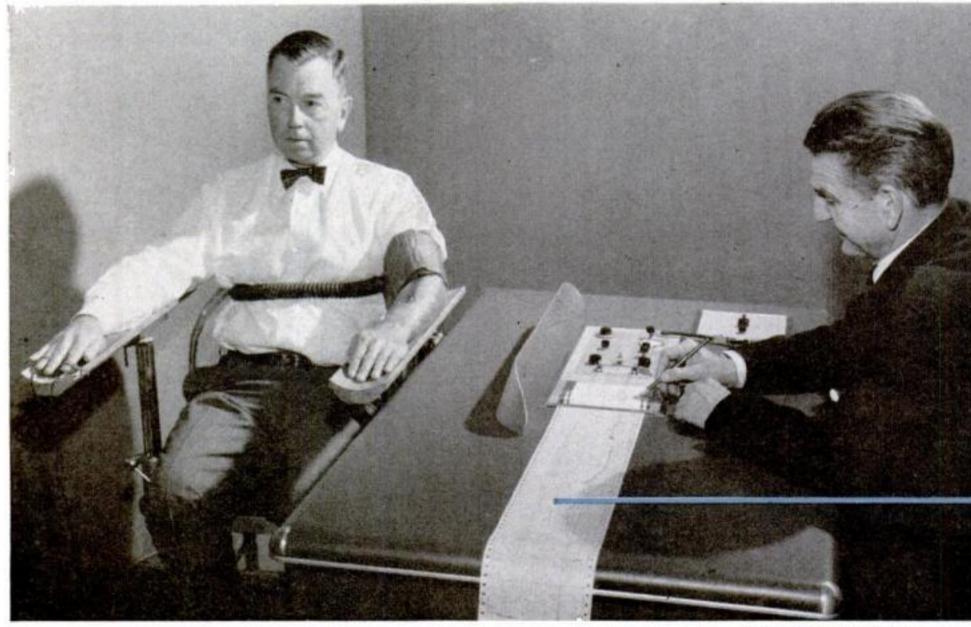
PS Picture News





Each reel contains a half mile of wire, and a helicopter carries 200 reels. GIs in the 101st Airborne Division at Fort Campbell, Ky., thought up the idea. Earlier flights had a four-mile limit with a wire-paying jeep or mechanical mule slung under the bird. It's all the wire the vehicles can carry.

I Lied to a

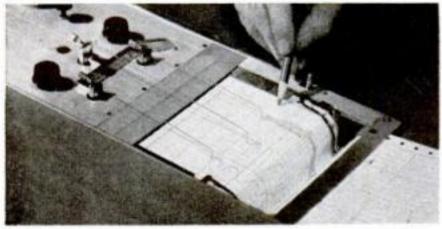


Photos by Robert Austin

By Wesley S. Griswold

I STOLE a wallet, right under the noses of the Los Angeles police. In fact, a tall, grinning sergeant watched me do it.

The wallet was crammed with stage money—\$510 in make-believe bills. I swiped it as part of a conspiracy with the sergeant to see if I could fool a lie detector. The plot failed. The lie detector, whose proper name is polygraph, caught



KEEPING TRACK OF EMOTIONS, the three styluses of the polygraph write the record of the author's instinctive reactions to questions. The graph paper moves at six inches a minute.

me cold in the only lie I told. Here is how it happened.

From reading scores of crime stories in Los Angeles newspapers, I had long been aware that the local police frequently give lie-detector tests to suspects, witnesses and surviving victims—when they can get the individual's consent.

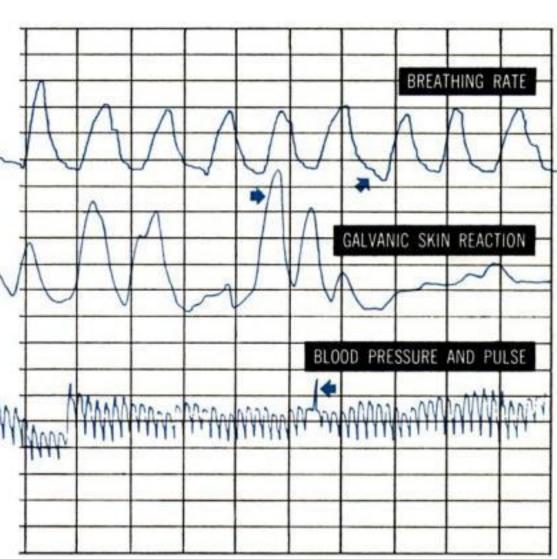
This struck me as curious, for I knew that California law does not permit the result of a polygraph test to be used as evidence in court—except on the rare occasion when defense, prosecution and judge all agree on it in advance. Most states are as stern as California in their skepticism about lie detectors.

Why, then, I wondered, does the Los Angeles Police Department, widely known for its devotion to scientific methods, persist in consulting this legal outcast, the polygraph? Is the gadget more reliable than the law will admit? How does it work? How sensitive is it? Can it be deliberately deceived?

With these questions in mind, I arranged to get acquainted with a lie

Lie Detector

THE FIBBING AUTHOR (far left) gazes at a blank wall in Los Angeles Police Headquarters while Lt. George H. Puddy, operating a lie detector, notes telltale record of a falsehood. The evidence of a lie is indicated by arrows on this strip of graph paper. The peak in the middle line is the galvanograph's record of the author's unconscious rise in tension as he prepared to fib. The sharp blip in the bottom line shows that his heart made a little leap. The quavery downstroke in the top line is the track of a sigh of relief that the lie was over.



detector at the handsome new police headquarters.

My conspirator there, the sergeant, first asked me to choose one box from a pile on his desk, and take what was in it. The box I picked contained a wallet.

"Count the fake money in it before you put it in your pocket," the sergeant said. I did so.

"Now," he said, "I'm going to turn you over to our chief polygraph operator, Lt. George H. Puddy. He's assistant commander of the Scientific Investigation Division. I'll tell him you've stolen a wallet, but he doesn't know how much money is in it, and you're not going to tell him. However," he added, with a wink, "he'll find out!"

That's pretty unlikely, I thought. The sergeant led me through a series of doors to a plain little room deep inside the building, far removed from distracting sights and sounds.

The remote room we finally entered had bare brown walls and very little furniture. There was a straight chair, with



MOST SENSITIVE INDICATORS of the emotional flurries that accompany lying are very often the polygraph's electrodes. They register nerve tensions that make the subject's fingers sweat.

elongated wooden arms. Beside it stood a steel desk. There was a rectangular opening in the top of the desk, and some knobs and a rubber bulb next to the opening, which contained a strip of graph paper with three styluses resting on it. The desk had a chair, and in one corner was a coat rack. That was all.

Actual criminal cases show how lie detector aids cops



Who killed the Black Dahlia?

The murderer of this unfortunate girl, whose weirdly mutilated body was found in a vacant lot in Los Angeles early on the morning of Jan. 15, 1947, has never been caught. Yet at various times since then, 37 men have confessed to the killing. The polygraph has clearly demonstrated that every one of them, for incomprehensible reasons of his own, was lying. Investigation confirmed its findings.

A recent lurid case in which the polygraph figured importantly was that of Mrs. Elizabeth Duncan, of Santa Barbara, who was found guilty of having hired a couple of Mexican laborers to murder her daughter-in-law. The testimony of two key witnesses in an early stage of the case, when the victim was known to be missing

but not to be dead, was seriously questioned by investigators. One witness, an aged lady, was thought to be imagining things. The other, believed to be telling the truth, was lying. The polygraph proved the first was a dependable witness, and so exposed the other's lies that she confessed to them. The case thereafter quickly developed as one of murder.

On another occasion, a middle-aged Los Angeles barfly was found in a remote glen with her head bashed in, and seven men were under suspicion. The polygraph helped eliminate all seven and pin the blame on a previously unsuspected eighth, who was the actual murderer. Unnerved

by the polygraph, he admitted it.

The lie detector also has had its lighter moments. Not long ago, it gave Los Angeles police unmistakable evidence that a burglary suspect reacted with strong emotion whenever cherry pie was mentioned. When this fact was revealed to him, he looked dismayed, and admitted his guilt. He had made the mistake of leaving his trademark behind. Somehow, he couldn't resist eating his favorite food whenever he found it on premises he was burglarizing—cherry pie.

I hung up my coat and sat down on the straight chair. Lt. Puddy walked in. He was a husky, genial, middle-aged man with the quiet cultivated voice and manner of a professor.

He explained that he knew I had the wallet. He was going to ask me a series of questions in an attempt to find out how much money was in it. I was to answer "No" to each question, whether that was truthful or not, and say nothing more.

I was to sit up, Lt. Puddy said, look straight ahead at the blank wall, avoid crossing my legs and, in fact, make no movements at all.

The lieutenant then rolled up my left shirtsleeve and fastened a conventional blood-pressure cuff around that arm.

"This will record your pulse and, of course, keep track of your blood pressure," he said.

He next hooked a length of corrugated rubber hose around my chest. "That's a pneumograph," he explained. "It records the rate and manner of your breathing."

Then he slid two ringlike electrodes over the first joints of two fingers of my right hand, and plugged a nearby cord into a wall socket.

"Now there's a very tiny electrical

current running through you—just a few millivolts," he said. "You can't feel it. But the amount of nervous tension in your body that will make your palms or fingers sweat will cause a temporary short circuit in the current. A galvanometer in the polygraph will register the short and one of the styluses will draw a peak on the graph paper."

Lt. Puddy returned to the desk, sat down and asked me if I was ready. I said I was. He squeezed the rubber bulb a few times, causing the blood-pressure cuff to grip my arm. Then I heard the whisper of the graph paper as it began to roll under the inked stylus.

"Did you take approximately \$200 from the wallet?" he asked softly.

"No," I said, in an unfamiliar voice. "Did you take around \$300 from the wallet?" he asked, in the same low tones.

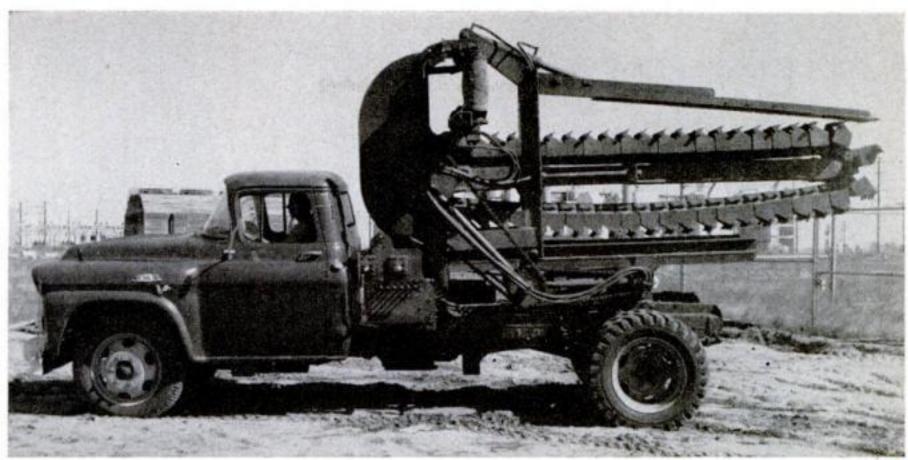
"No," I said, more firmly.

On went the questions, raising the sum of money \$100 each time, and on went the negative responses—until there had been seven.

Then Lt. Puddy looked up with a smile. "That's enough." He came over and released me from my chair.

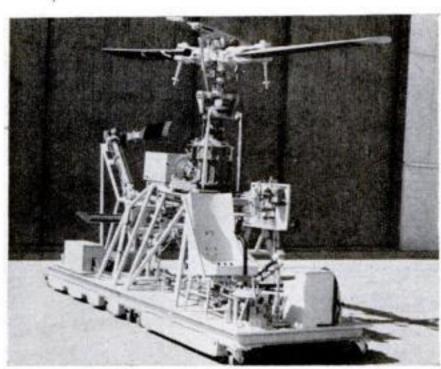
[Continued on page 216]

What Does This Truck Do?



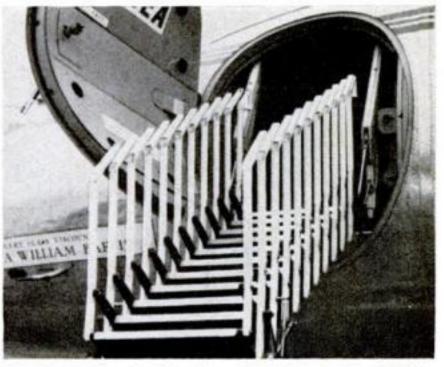
For sequence photos of the unusual rig in action, turn page



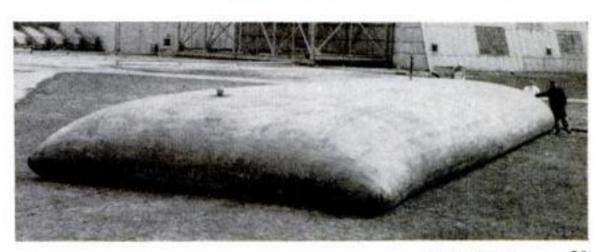


CUTAWAY COPTER. Army mechanics learn how Bell's HU-1A jet helicopter works by studying a full-size model. They watch parts move inside the rotor hub, gear boxes and transmission through glass windows.

Bunyan could rest his head on this largest "pillow" in the world. Goodyear made the 24- by 64-foot rubber-coated nylon tank to hold 50,000 gallons of fuel oil or other liquid. Empty it weighs one ton, rolls up.

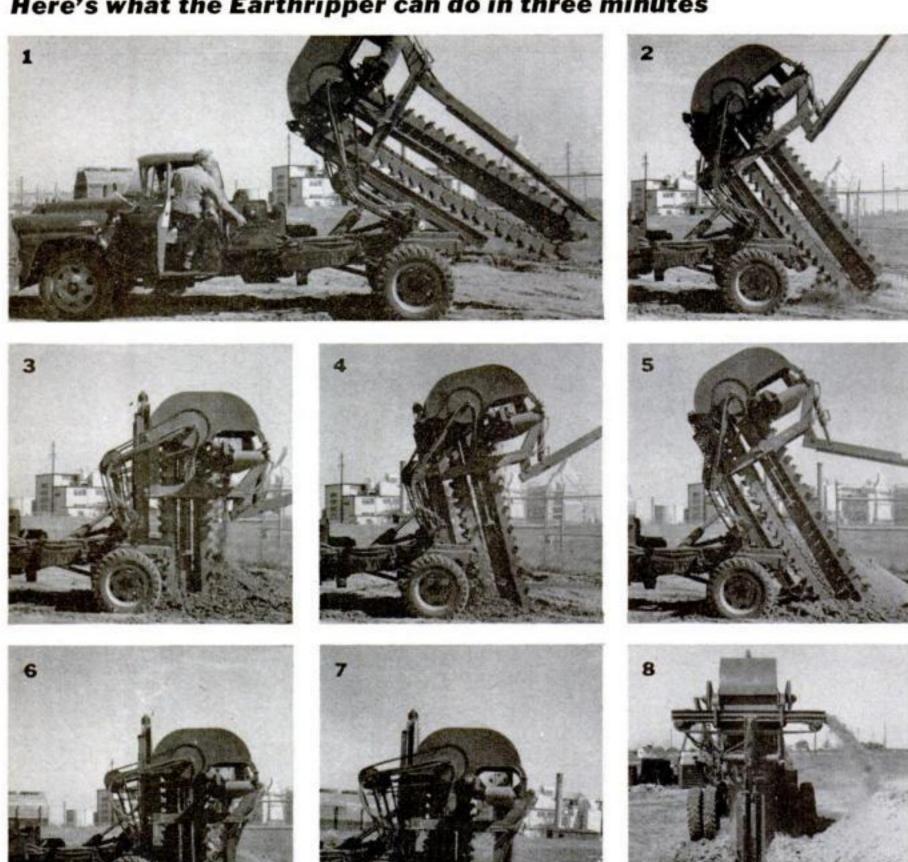


STAIRS FOLD INTO PLANE. This Viscount airliner needs no boarding ramp—it carries its own stairway inside. The steps, made of light metal alloy, are hydraulically folded like a Venetian blind into a small space inside the plane.



CONTINUED

Here's what the Earthripper can do in three minutes



EARTHRIPPER is the fastest, neatest mechanical ditch digger in the world, the maker claims. Ready to dig 30 seconds after it leaves the road, the machine tilts backwards and claws its own hole in the ground. Without extensions it can burrow 91/2 feet straight down; with them it goes 12 feet deep.

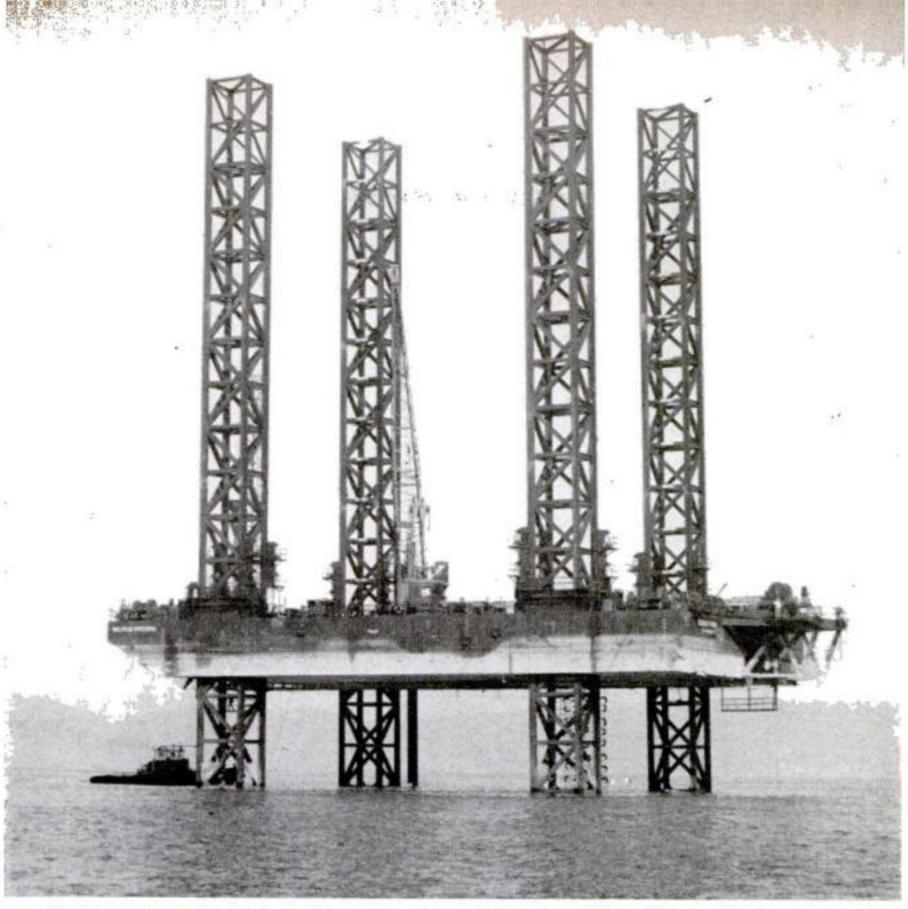
Once the toothed buckets have chewed their way to the desired depth, the truck gets underway. It pulls Earthripper's buckets along with it, quickly extending the hole into a ditch. At a trench depth of six feet, for example, the rig moves 23 feet a minute. If the buckets start to bite into buried pipes or cables, a slip clutch temporarily disconnects power to prevent damage to the underground installations and the machine.

Dirt scooped out can be spewed to either side of the ditch at whatever rate the operator wishes, independently of the digging speed. In one minute, under ideal conditions, Earthripper digs up 170 cubic feet of dirt-it could fill a gondola railroad car in less than 15 minutes.

The designer and builder of Earthripper is C. W. Pewthers of Bryan, Tex. Pewthers built a successful rubber-tired ditching machine in 1946. This latest one is radically different, however.

Buckets and their supporting boom are hydraulically powered. The boom can be positioned to dig in any direction —down, at an angle, even straight back into a vertical bank.

94 POPULAR SCIENCE AUGUST 1959



A mile from land, its feet on the ocean floor, biggest mobile offshore rig lays sewer pipe

Giant Pipe-Layer Walks on 275-Foot Legs

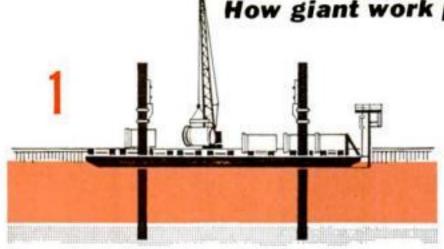
When hydraulic legs are drawn up, platform can be towed or winched to a new location

A GIANT ocean-going work platform with four huge legs of steel, each 275 feet high and 17 feet square, is now the oddest sight in Santa Monica Bay, Cal. On those great legs, the plat-

form can lift itself high above the waves. It can either stand firmly in water more than 200 feet deep, or lower itself until it floats.

This 4,500-ton mobile platform, christened the George F. Ferris, is said to be the largest of its kind in the world. It is busily engaged on a job that has never been done before. Using cranes and winches, it is setting a mighty pipe on the

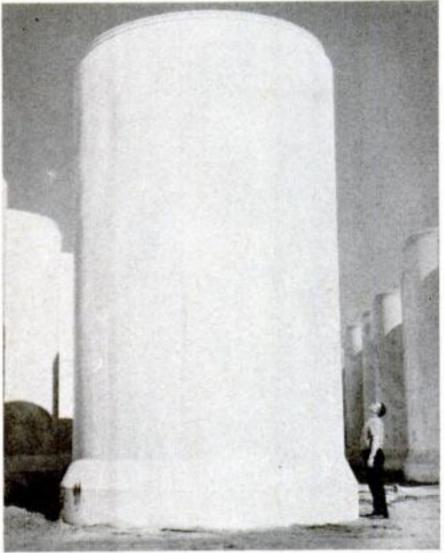
How giant work platform lays pipe on the ocean floor



SECTIONS OF PIPE are assembled on a dry dock at Long Beach, in units of six sections.



be maneuvered by cranes to position over pipe.



LITTLE MAN, WHAT NOW? This monumental section of pipe is 24 feet long, 12 feet in diameter.

Eight sections compose one unit in the system.

PONTOON AND PIPE UNIT are launched at Long Beach. Lashed together, they will be towed to the work site off El Segundo, 30 miles away.

ocean bottom. Mostly 12 feet in diameter, it will reach out into the sea for nearly six miles. Toward its end, the pipe will branch out in two long, slimmer arms for a few thousand feet more.

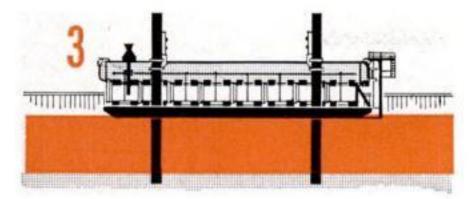
Each unit of the main pipe is 192 feet long and weighs more than 600 tons. When fully assembled, some time next year, the pipeline will carry discharge from Los Angeles' main sewage-treatment plant at El Segundo into deep, distant water, where it cannot contaminate bathing beaches.

Sections of pipe for the George F. Ferris to lay on the floor of the bay off El Segundo are made on the waterfront at Long Beach. Each section is 24 feet long. Eight of them are fitted together, lashed to the bottom of a 212-foot pontoon and towed north 30 miles to the work site where the pipe-laying platform takes over.

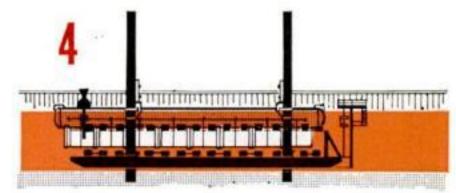
Lines from winches mounted on traveling cranes at the platform's bow and stern are fastened to hooks at both ends of the pontoon. These lines move the pontoon forward, backward and sideways until its position is precisely right. Then the pontoon is partially flooded, and let down through the water until the pipe is within one foot of the bottom. Pontoon and pipe are then winched along until the pipe forms a joint with the unit previously laid.

The pipe must never deviate more than five feet from a straight line. To avoid errors in fog or storms, exact positioning is done by triangulation with microwave apparatus. An instrument called a Tellurometer transmits continuous microwaves on a frequency of 3,000 megacycles. Two receivers on shore, one on each side of the pipeline, receive the impulses and relay them back to the transmitter. The time it takes for the

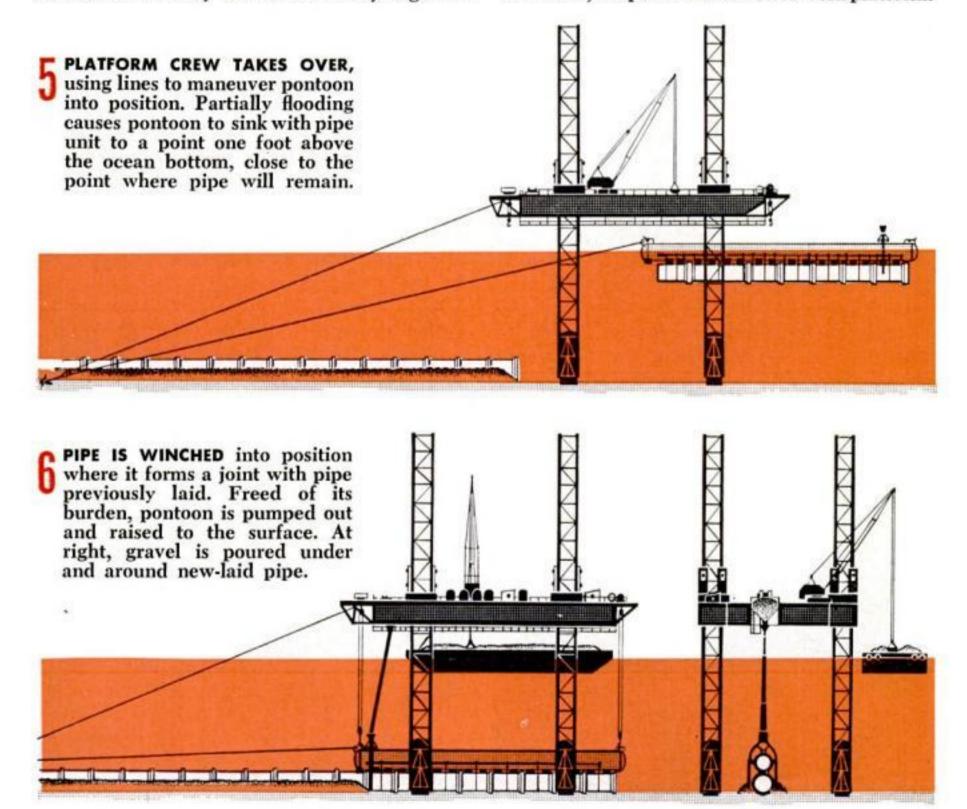
as it wades the six-mile route of novel sewage-disposal system



PONTOON AND PIPE are lifted by dry dock to surface where they are lashed firmly together.



PARTIALLY SUBMERGED, with pipe assembly under water, the pontoon is towed to work platform.



microwaves to make a round trip is an exact measurement of the distance.

As the pipeline moves into deeper and clearer water, the jointing process will be watched from the platform by means of closed-circuit television with cameras mounted on the sunken pontoon.

After the joint has been made, a telescopic pipe reaches down, like an elephant's trunk, and is connected with a pair of chutes, on rails, that straddle the sunken pontoon. Then, as the crane travels slowly along, gravel from hoppers on the platform is poured down this pipe and through the chutes, forming a snug cradle for the sewer pipe.

When that job is done, the pontoon is released from its burden and brought to the surface. Pumping it out gradually on the way up prevents it from popping out of the water. It is then ready to go back for another load of pipe.



NO DECK GAMES aboard the offshore rig George F. Ferris. Much of the available space is taken up by huge gravel bins, filled from tug-drawn barges. Also on deck are traveling cranes, tractors and other gear for laying 192-foot sections of sewer pipe, weighing 600 tons per unit, on the ocean's floor. At some points this is more than 200 feet beneath the surging surface.

Once a section has been added to the lengthening conduit on the ocean floor, the George F. Ferris lowers itself into the water, lifts its ponderous legs off the bottom and is all set to float to the next location. It climbs up and down its box-girder legs by means of powerful hydraulic jacks, whose horizontal pins fit into square notches along the flanges of the girders. The action, on a grand scale, is much like that of an automobile jack.

In the base of each leg is a large pontoon which provides a broad, flat foot. This pontoon makes it easier for jacks to lift the leg when it's time to move. Once afloat, the platform hauls itself ahead by pulling on forward anchor lines and paying out the lines to its stern anchors. It will have to go through this "walking" process 170 times before its job in these waters is done.

The George F. Ferris was towed 450 miles down the coast from Richmond, where it was built. It had to lower its legs slightly to duck the Golden Gate Bridge, then lift them to their full height to avoid a sandbar. But there was nothing brisk about this process: The platform's legs are jacked up or down at a speed of 40 feet an hour.—Wesley S. Griswold.

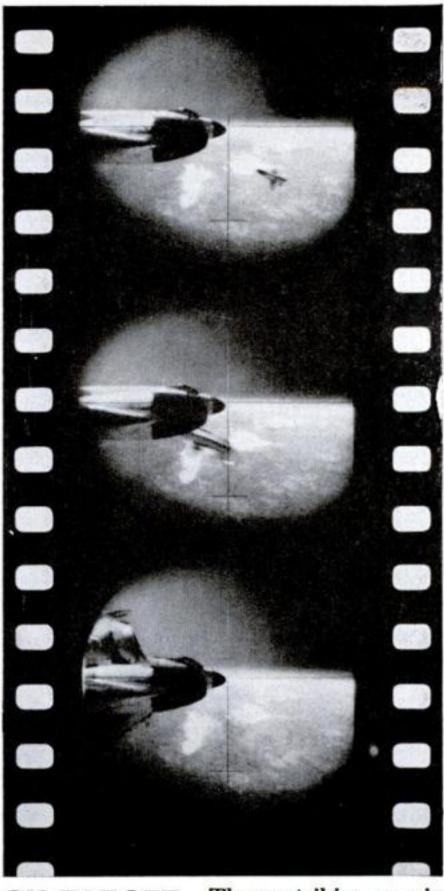


BOARDING NET, slung over the starboard side, enables crewmen returning from shore leave to climb aboard their strange ship, which, in this photo, is standing on the ocean floor.

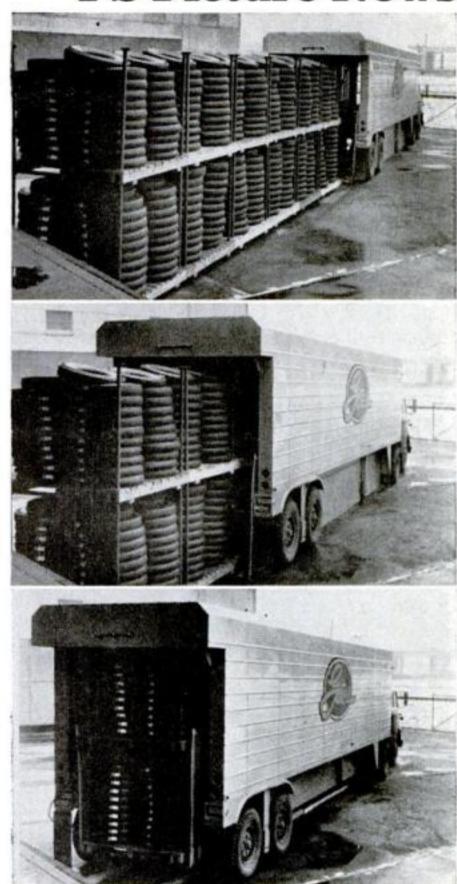


SEA LEGS DRAWN UP, the George F. Ferris barely clears the Golden Gate Bridge in San Francisco Bay on her maiden voyage to her work station. An ocean-going tug provides power.

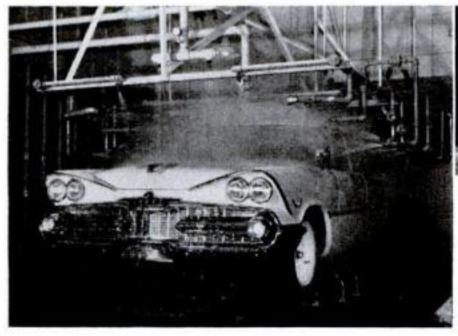
PS Picture News



ON TARGET. These striking movie frames of a direct hit by a British Bloodhound surface-to-air guided missile were taken by a camera on the wing tip of the destroyed target drone. The camera was parachuted to the ground after the hit.



BIG MOUTH. Here's a truck trailer that swallows its load. The big vehicle, made by Straddle Trailer Corp. of Denver, is shown, top to bottom, with hydraulic-controlled side shelves down, backing on a load and with load in place.





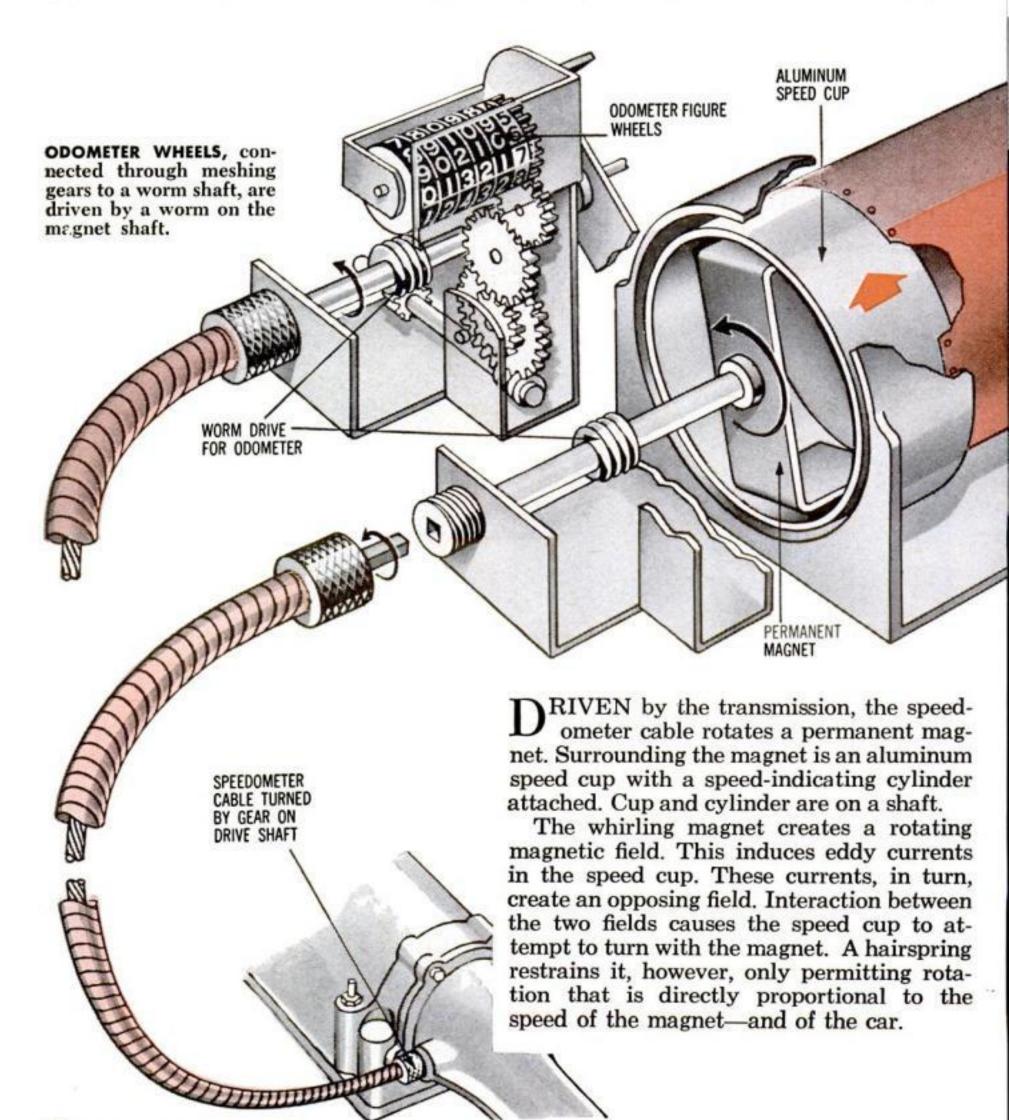
CAR DUNK. The new Dodge at left gets a shower at the rate of $15\frac{1}{2}$ feet of water an hour sprayed at 30 pounds' pressure from all angles. Above, a factory inspector, flashlight in hand, examines seals at the windshield for leaks.

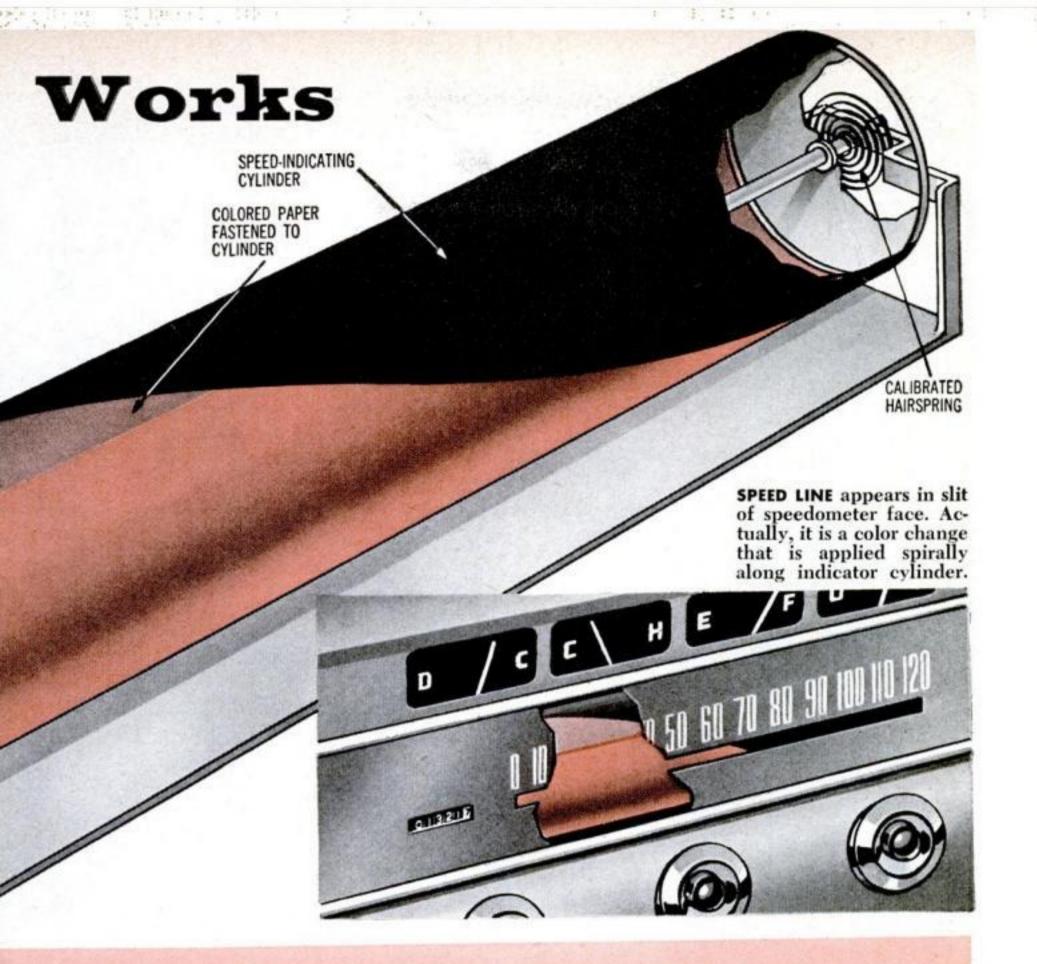
How a Speedometer

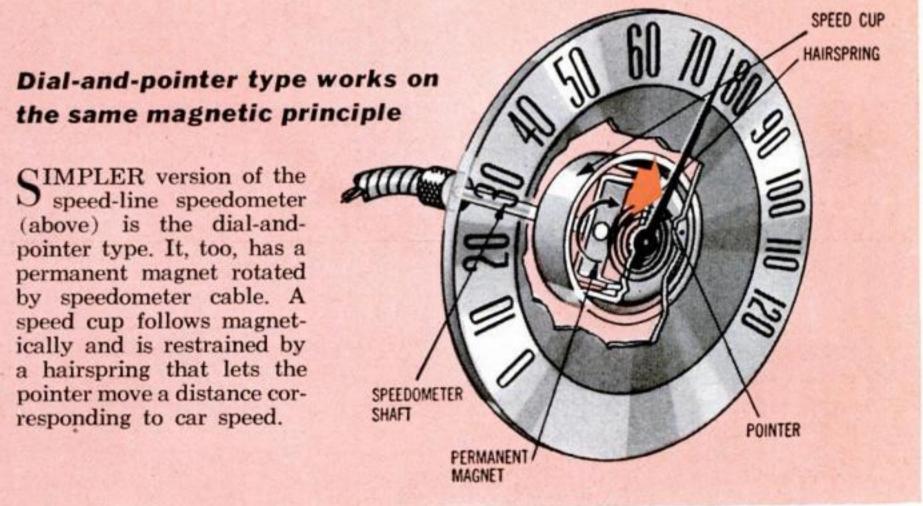
SPEEDOMETERS have been on automobile instrument panels for over 50 years. And during most of that time they've changed little. One early change shifted the driven end of the cable from a front wheel to the transmission. More recently, some cars have sported a speedometer with a horizontal "speed

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line," rather than the pointer on a dial. Despite outward differences, speed-ometers all make use of the magnetic principle described below. They have something else in common: By S.A.E. standards, speedometer cables in American cars are now geared to make 1,001 r.p.m. at 60 m.p.h.—Erik H. Arctander.

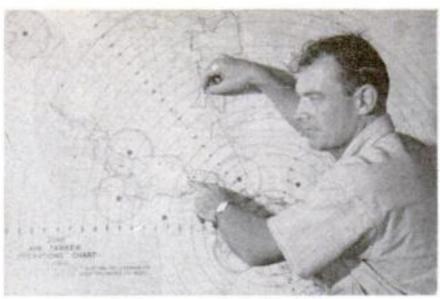








TAKEOFF ORDERS for the aerial tanker fleet come to mobile headquarters by radio.



LOCATION OF FIRE is pinpointed on an operations chart; direction, distance noted.



POWDERED BORATE and other chemicals are dumped into hopper, water hosed into mixture.



SLURRY TANK HOLDING 1,250 GALLONS protrudes from belly of a loaded B-25 bomber.

"Air Raid" on a Forest Fire

VETERAN hedgehoppers in the Los Angeles County Fire Department form an Initial Attack Group to protect forests. They douse trees with flame-retarding slurry at the start of a fire. The slurry, a gravy-thick mixture of sodium, calcium and borate in water, gives trees and underbrush a sticky coating that just won't burn. Spread from low-flying planes, it fireproofs an acre an hour.



PEACE SPEARHEAD. The just-completed headquarters of the North Atlantic Treaty Organization in Paris is symbolically designed as the point of a spear. Its basement will park 500 cars.



FRONT-HINGED HOOD. Britain's new small Triumph Herald—earmarked for export to U.S.—permits full access to its 38.5-hp. engine with a hood opening forward. It comes as a sedan or a coupe.



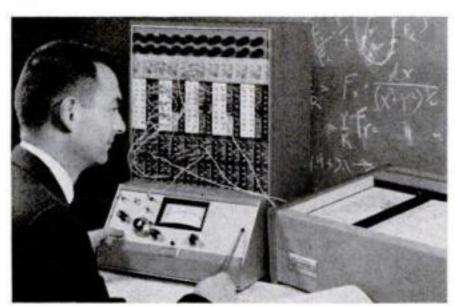
TORPEDO BOMBER takes on load pumped through hose into its 600-gallon tank. Other planes in fleet include PBY flying boats converted into fire-fighting tankers. Some carry multiple tanks, dumped one at a time or all together. Delivery capacity has peaked at 17,550 gallons an hour to smother burning timber.



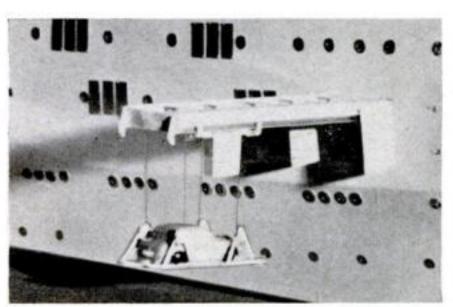
cade down from triggered belly doors of a torpedo bomber flying low over the trees. It blankets fire before it can get out of control.

plane is hosed down. Here, a fire-fighting pilot inspects PBY's after tanks to be sure no traces are left of the heavy borate slurry.





DESK-TOP COMPUTER. This little analog computer measures 15 by 17 inches at its base. It is built by Electronics Associates to do engineers' everyday computations with high accuracy.



CAR LOADER. Britain's 45,000-ton liner Canberra has a hoist on rails for direct loading into a 60-car garage in the hold. Purpose: To make passengers' cars easily available at ports of call.

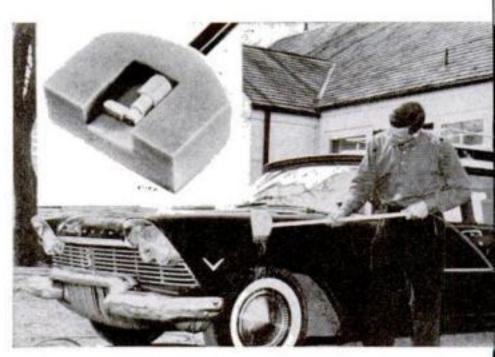
WHAT'S NEW.



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Tall Doors Add Space, Cut Cost

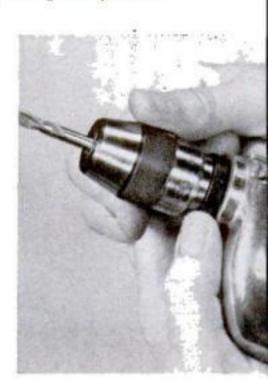
Besides saving bumped heads, new floor-to-ceiling doors like the one at left are said to cost less and look better. They eliminate conventional framing, let in more air and light and make rooms seem higher and more spacious. The 8' whoppers, soon available at lumberyards, have tough, warp-free, yet inexpensive facings of special hardboard. Masonite Corp., 111 W. Washington St., Chicago 2.

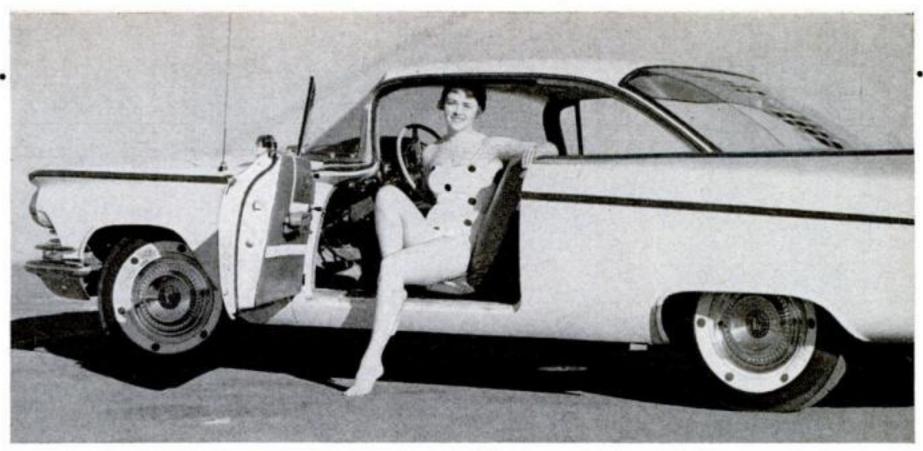


CAR WASHER. Pressing the sponge on this hose-fed washer trips a built-in valve that turns the water on or off, to save you running to the faucet. About \$3, Hopkins Mfg. Corp., Emporia, Kan.

QUICK BIT.

You can change drill bits quickly with a new chuck that needs no key to lock it. Ball bearings inside let you spin it tight with finger pressure alone. The chuck is sold by itself or on new 16 and 1/2 drills. Sears, Roebuck, Chicago.





a racy look to your car's tires by cementing on small colored disks of rubber.

Made for either white or black sidewalls,

they're said to stick on even if tires are curbed. Roger Berg, 3400 S.W. 108th St., Beaverton, Ore. Yep, you can even decorate your wife with matching dots.

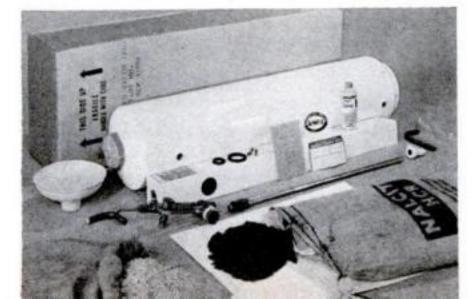


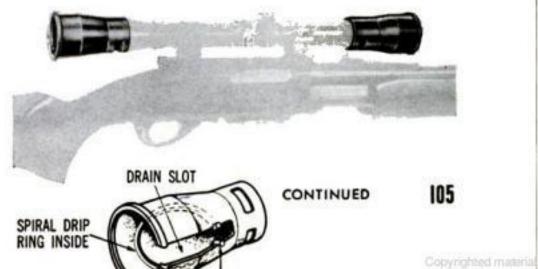
SPOOKY SPECS. Clipped to regular glasses, this eye shield tilts down to become sunglasses, up to become a shade. For night driving, it slides halfway up so that a slight down-tilt of the head

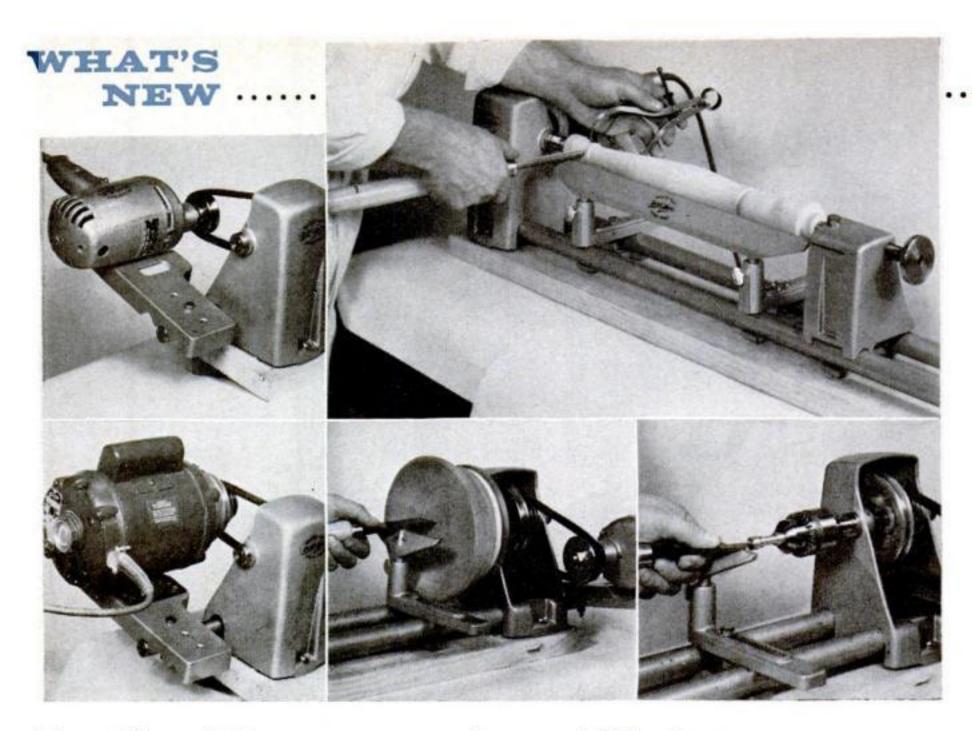
protects a driver's eyes from oncoming lights without obscuring vision. It comes in sizes and styles for men and women for about \$1.65. Nova Device Co., 136 Fulton St., Brooklyn, N. Y.

KIT SOFTENS WATER. You're said to save half the cost of a water soft-ener with this kit. It includes an epoxylined tank and all parts. Manual and automatic models are \$149 up. Associated Water Ind., Military Rd., Buffalo.

SNAZZY SIGHTS. Slipping these neoprene hoods on a telescopic sight dresses up a gun and keeps rain, snow and sun glare off the lenses. Four sizes fit most scopes. About \$3 a pair, PGS, Inc., 622 Gratiot Ave., Saginaw, Mich.





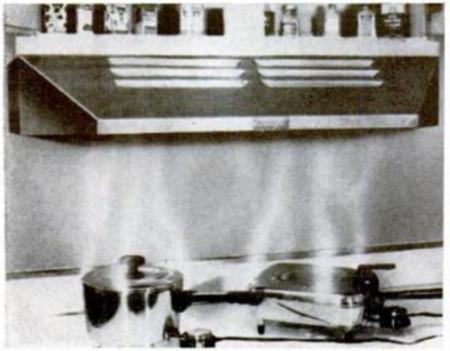


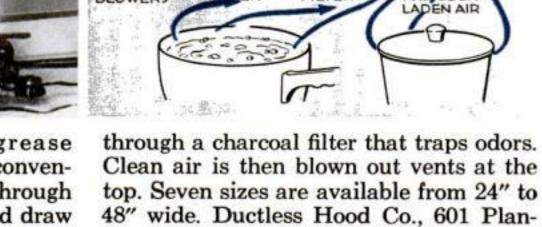
Lathe Runs on Any Motor

An ingenious motor mount on this lowcost lathe lets you use any power that's handy—a conventional motor, portable power pack, even an electric drill. The notched mount moves in and out to suit belt length and tilts up for quick changing of belt speeds on a four-step pulley. Extra chucks for holding rod stock or bits can be mounted in either the head- or tailstock. The lathe has an 8" swing, 30" between centers, sells for \$34.50. Millers Falls Co., Greenfield, Mass.

GREASE

FLUORESCENT





VENT FOR CLEAN

CHARCOAL

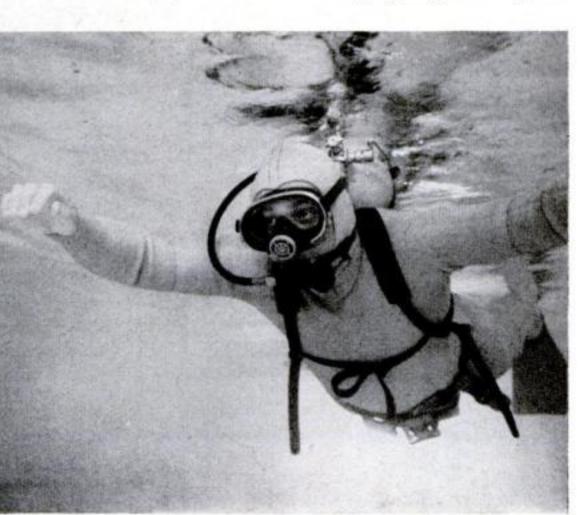
dome Rd., Manhasset, N.Y.

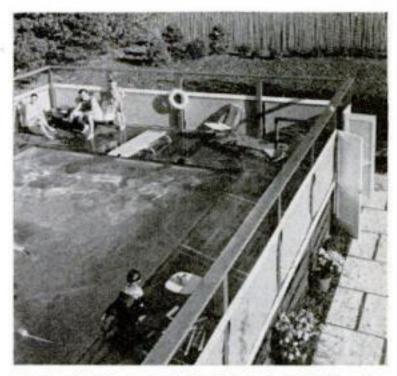
and odors out of kitchens where conventional exhaust ducts can't be run through walls. Twin blowers inside the hood draw tumes first through a grease filter, next

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TOO HOT TO SLEEP? Well, now you can crawl into bed with an electric fan. This cloth sleeve pipes cool breezes between the sheets from any 10" or 12" pedestal-base fan. About \$8, B & G Products, Spring House, Pa.





ABOVE-GROUND POOL fits any terrain, can be moved, even roofed for winter use. It includes deck, fence, filter, vinyl liner for \$3,000 up. International Swimming Pool Corp., White Plains, N.Y.



portable Headrest lets your copilot catnap comfortably on long car trips. It can also be used as a beach pillow or backrest for reading in bed. About \$5, Mitchell Co., 1601 Ballman Rd., Ft. Smith, Ark.

HOMEMADE SUIT for skindiving comes as a kit. You get material, patterns and instructions for cutting the pieces and cementing them together. Made of a buoyant vinyl, the suit is said to float a diver in an emergency. It comes in four colors; about \$45. Skope Mfg. Corp., Norwood, Mass.

How Safe Is Our A-Ship Savannah?



Engineers dreamed up worst possible accidents that might befall first atomic merchant vessel. Then they designed elaborate safeguards so radioactivity could never leak out

A SHIP without a smokestack, just launched and now receiving its finishing touches at Camden, N. J., will write maritime history with its maiden trip early in 1960.

The 595-foot vessel is the 21,800-ton N. S. (nuclear ship) Savannah, the first atomic-powered merchantman.

On a single loading of A-fuel, the Savannah will have a range of 350,000 nautical miles, enough to take it 16

times around the world. It will carry 60 passengers, 10,000 tons of cargo. Its 20,000 horsepower will propel it at a cruising speed of 20 knots or better.

Heart of its propelling machinery will be a pressurized-water nuclear reactor similar in type to the one that generates electric power at Shippingport, Pa., and about a third as powerful. Fuel for the atomic "fire" will be uranium oxide,

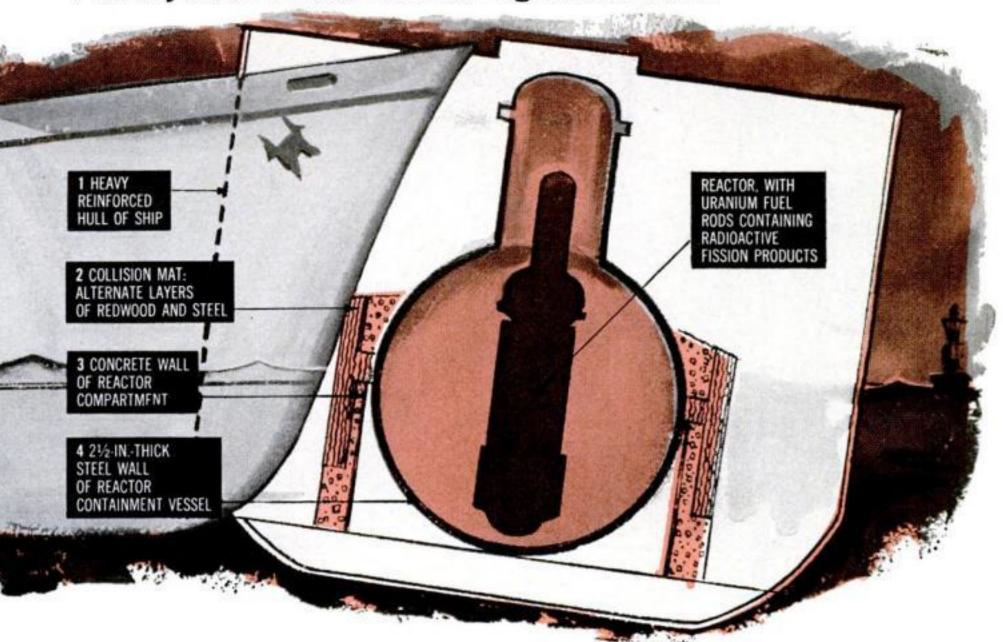
[Continued on page 204]

CONTAINMENT VESSEL REACTOR RADIOACTIVE FISSION PRODUCTS FROM MELTED FUEL MELT HAS COOLED ENOUGH TO BE UNABLE TO PENETRATE CONTAINER

Even reactor's burning up would risk no lives

WORST IMAGINABLE ACCI-**DENT** would be overheating and meltdown of atomic furnace—from loss of cooling water through a broken pipe, for example. Even then, containment vessel would prevent catastrophe. It is large and strong enough for all of cooling water to turn to steam without bursting it. Loss of water would automatically stop runaway, since moderating effect of water is needed to keep chain reaction going. Heat from radioactivity of fuel rods might melt reactor core, but container would trap loosed fission products.

Four layers armor atomic vitals against collision



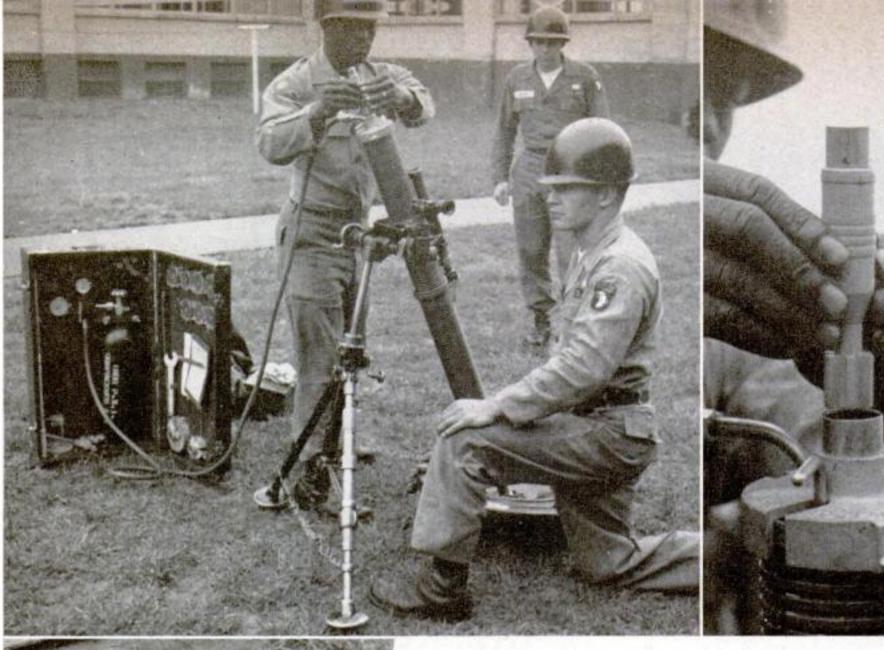
ship from breaching the chamber holding the nuclear reactor, and loosing dangerous radio-activity. Only one of the world's largest vessels, running at high speed in the open sea, could possibly penetrate as far as the innermost $2\frac{1}{2}$.

inch-thick wall of steel. In that case the reactor containment vessel might be dislodged, but would not be punctured. In planning safety precautions, designers figured on unluckiest collision: a prow squarely knifing section of the Savannah containing its reactor, as pictured.

Safeguards seal ship if it founders

IN CASE SAVANNAH SINKS, reactor would automatically be shut down and chain stopped. reaction Oneway valves would let sea water flood the reactor containment vessel, but would not allow contaminated water to escape to ocean. Still further precautions are provided in case depth were so great that the reactor could not be salvaged. Divers would then be sent down to attach hose to special fittings atop the containment vessel and pump it full of concrete, entombing the radioactivity in an impervious, solid block.



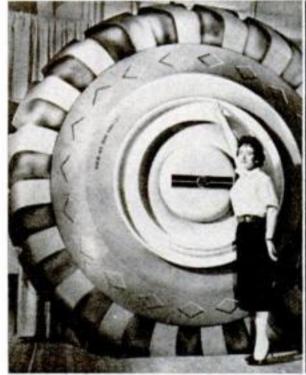


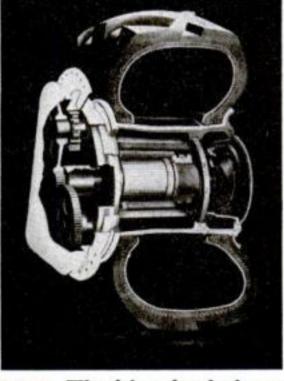




at Fort Campbell, Ky., save by using miniature mortar blanks instead of \$14 shells.

The six-inch blank, compared with full-size shell in drawing, costs less than a cent a shot. Blanks are fired by compressed air from an adapter (above) at a bucket (left) with an accurate range of an inch to the yard.





HUB-MOUNTED MOTOR. The big wheel above has a built-in electric motor. It is made by GE for heavy earth movers. The motor is driven by an engine-powered generator, needs no transmission or gearshift.

sun cooler. The zany helmet below utilizes the hot sun to keep its wearer cool. A solar battery on the top supplies current to run a small electric fan mounted on a chin strap in front of his face.



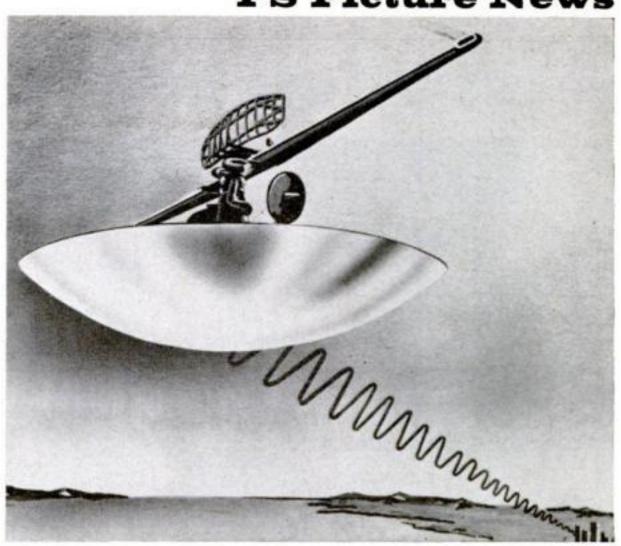
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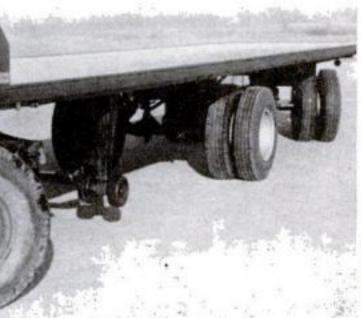
PS Picture News

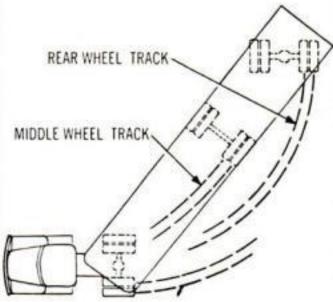
The flying dish at right would be kept aloft by power from the ground. Heart of the system is an Amplitron tube developed by Raytheon to transmit high-frequency microwaves more powerful than those from the magnetron used in radar.

Energy received would provide heat to run a gas turbine compressing air to spin helicopter rotors and keep the station up 30,000 feet or more.

Raytheon hopes to build a model for Air Force tests in missile warning, navigation aids, long-range TV and radio.







REAR STEERING.

The middle axle of the 40-foot trailer at left is fixed, the one in rear is pivoted. This device, developed by Trans-Equipment Corp., Columbus, Ohio, keeps rear wheels of a long trailer within the arc of tracks of its tractor. Anything the tractor clears also is cleared by the trailer.

KEY WATCH. The Swiss-made watch below is mounted on a car key so it will be upright when the ignition is on. It has a luminous dial, an alarm to awaken a dozer, warn of overtime parking.







WATCHWORD. Sidewalk superintendents viewing progress on the new Western Electric building in downtown New York get a taped description of the work by phone. What they see through windows is shown at right.

In Baltimore, where the "traffic cops" are electronic computers—

Drivers Make Their



Own Green Lights

By John C. Schmidt

ENRY BARNES in Baltimore is waging a fight against the great American traffic jam, with electronic computers his main weapon. Despite a nine-percent annual jump in the traffic load during his first five years on the job, the tide of battle appears to be going in his favor.

Traffic engineers from cities all over the country are keeping an eye on the Baltimore system. Denver, Philadelphia, Detroit, Los Angeles are among the big cities that have climbed on the electronic bandwagon to solve their traffic problems.

Baltimore's traffic headaches are those of many large cities. Narrow streets laid out before automobiles existed carry not only the daily ebb and flow of carhappy commuters, but also the main stream of interstate traffic.

Before Barnes came into the picture, traffic control was under a handful of commissioners who were given cast-off police cars, had virtually no money to spend for improvements, and debated the placement of every sign. Traffic signals were timed by a \$69 electric clock at Police Headquarters. They clicked monotonously red and green, the same at 5 p.m. as at 5 a.m. Traffic was rapidly reaching the point of self-strangulation.

City fathers ask for help. From Denver they brought a traffic engineer who had gained recognition for introducing an "all-walk" phase at busy intersections to give pedestrians a fighting chance. Dubbed the "Barnes Dance," it's a step people are doing all over the country today.

Barnes, who started as a police electrician in Flint, Mich., drove a hard bargain with Baltimore. But he put his case so convincingly that he came away with a higher salary than the mayor, a 250-man staff of specialists, almost unlimited authority in traffic matters, a vastly increased budget, and complete freedom from political pressure.

In five years, these are some of the



RADAR SAMPLING DEVICE (one of many) is shown suspended over a street at the end of a pole. It feeds information on the movement of traffic back to the big electronic brain.



puts an inspector in immediate touch with headquarters. System supplies city with independent communications link in case of disaster.

things he has done for Baltimore traffic:

 Designed and installed the largest all-electronic traffic control system in the world, a completely automatic setup which governs signals at more than 900 intersections.

 Installed more than 68,000 signs, including 9,000 bright red STOP signs to create a system of arterial streets.

 Put enough reflectorized lane-marking paint on the streets to draw a solid strip right back to Denver.

 Spent \$9,000,000 to give drivers the "green light."

Has it been worth the price?

Barnes has plenty of critics, but most drivers-even taxi drivers—agree he's done a good job. They are backed by statistics which show that 1,200 cars perlane-per-hour now move in streets where only 450 moved before. He figures that a \$50,000 signal installation on one street took the place of street improvements which would have cost \$50 million.

The nerve center for his attack on the traffic load is a master electronic "brain"

—a row of gray metal racks filled with tubes, relays and selector circuits. And far from telling motorists what to do, the brain in effect lets drivers create their own green lights by adjusting signals all over the city to meet the demands of the moment.

Information on the traffic flow in all directions comes in from dozens of radar samplers located on key streets. These give a picture of the ever-changing flow of cars, reporting their density, speed and direction to a battery of eight master units. Every six minutes the brain takes a fresh look at the over-all situation. Then from 220 possible timing combinations, it selects the one which will most effectively move the load. It always favors the heaviest flow.



STORM-EMERGENCY CENTER has six "hot-line" phones. These provide 24-hour contact with police, fire, highway departments; transit and power companies, civil defense.

Automatic selectors choose from six background cycles ranging in length from 50 to 120 seconds. The computer can also set up three possible "splits," or red vs. green time for a particular light, and can provide five variations in "off-set," or the progression of greens from block to block.

When a change is needed, the master unit sends out impulses to secondary controllers which tell each light what to do. At rush hours, for example, the brain selects the longest possible cycle, favorable to the movement of large masses of

> closely bunched cars. Lighter traffic calls for a faster-changing pattern.

> The brain works 24 hours a day, its relays clicking and small neon bulbs flashing orange—each flash indicating that a car has passed under one of the radar samplers.

Working along with the computer is an elaborate communications system. There is a radio room which looks like any small commercial radio studio, but the "program" is concerned only with what is happening on the city's streets. Receivers are tuned in

continually to police and fire department radio.

Dispatchers, on duty around the clock, have handled as many as 6,500 trouble calls in a 24-hour period. Within seconds after hearing of a signal burned out or a sign down, the dispatcher can have a truck on the way. Some trucks carry portable generators to light critical signals in case of power failure. Work orders are teletyped direct to the sections concerned; formerly these were mailed.

It took Barnes and his staff two years to design the new system. It was built by the Automatic Signal Division of Eastern Industries, Inc., and the "brain" part alone cost \$4½ million.



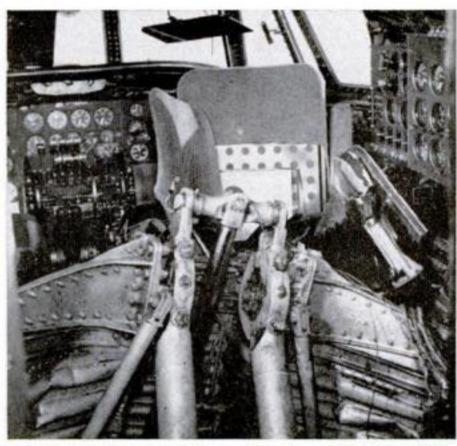
EASY FIX. Salvage and repair presented no at an airport. Note mechanic taping on matspecial problem when this plane cracked up tresses to cushion nose of the downed bird.

How Lockheed's wizard of the quick fix makes

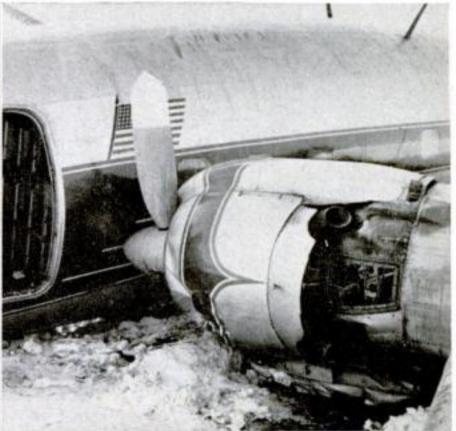
Crashed Airliners Fly Again By Eliot Tozer

A S LONG as airline pilots wash out a wing tip in a cross-wind landing, snap off landing gear by dropping in from about 75 feet up, or crumple a nose by taxiing into a gas truck, Neal Thomas is going to make money. A wiz-

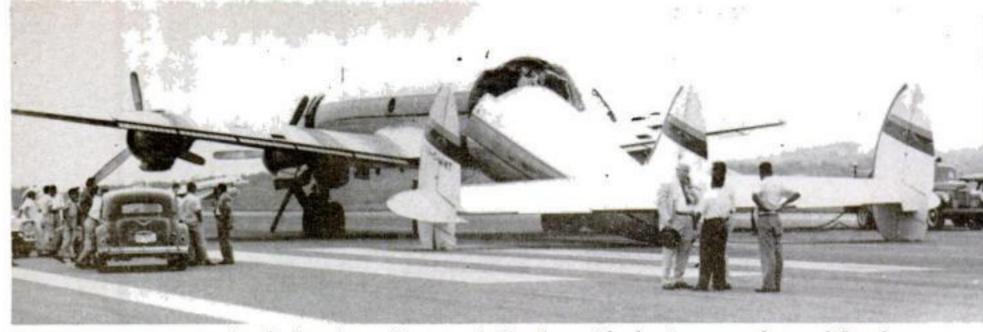
ard of the quick fix, he can tack a broken tail onto a DC-6 with baling wire. What's more, it will hang together until his pilot can nurse it home from the Arabian dune or the Greenland ice pack where it cracked up.



MAIN LANDING GEAR rammed copilot in this crash. But he and plane are both flying again.



ONE ENGINE came to rest nuzzling the fuselage after wreck. Most of the plane was salvaged.



A HARD LANDING at a South American airport broke this plane's back. Thomas splinted her

in jig time with aluminum patches and flew her safely back to N. Y. International Airport.

Neal Thomas' job is to take a quick look at a crippled bird on her belly in mud or snow and decide whether she's worth fixing. Sometimes a half million dollars rides on his decision. Often his life depends on it. After he has cobbled up a crashed plane with pieces of mahogany or sheet steel or whatever comes to hand, he usually rides it back to the repair shop at New York International Airport.

Thomas is Manager, Engineering, for Lockheed Aircraft Service—New York (LASNY), specialists in the jury repair

of cracked-up airliners.

A jury rig on an airplane is like the jury rig on a ship—a temporary repair. It's a fast fix that will hold the wings on until the mechanics can get her home. But the fix must meet airworthiness re-



FIRE IS A MAJOR WORRY. It's often hard to tell how badly wiring is cooked and internal ducting corroded. This plane wing burned when an impeller blade chopped a fuel line.

quirements of the Federal Aviation Agency. Thomas' patch on a DC-7's tail may look as though it will flap off when the Seven hits minimum cruise, but Thomas knows it's on for keeps. Or until he takes it off. And the FAA knows it, too. Thomas is not only a sharp mechanical engineer with a CalTech degree, he's a Designated Aircraft Maintenance Inspector for FAA.

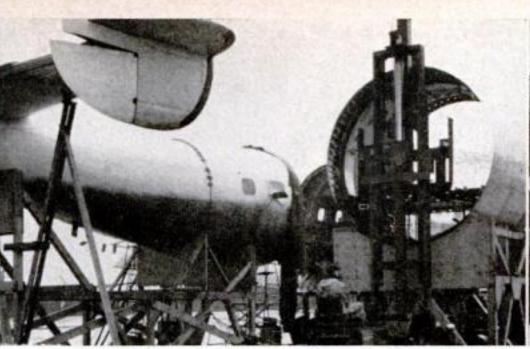
Jury repair is big business today. And it's high-pressure business. A downed airplane is a staggering liability. Every hour it lies on the ground it costs the owner hundreds of dollars. A Constellation, running at an average load factor of 60 percent on a transatlantic run, can

bring in \$259,000 a month.

Pressure doesn't keep Thomas from coming up with some pretty weird fixes —or cut down his fun jockeying the beatup birds back to LASNY. Take the time an impeller blade let go in the No. 3 engine of a transport on the taxi strip at Rio de Janeiro. A fragment chopped a fuel line in No. 4 engine. The resulting fire, fanned by a 10-knot breeze, was a five-alarm spectacular. When the flames died, the plane was a pathetic sight. The middle 30 feet of her 60-foot tapered wing was pocked with jagged holes. A layman would have said, "Put a new wing on it."

Quoting a price low enough to convince the airline that the plane is "economically repairable," yet high enough to make money for his bosses is the big job. This one was tough. From de-icer boot to trailing edge, the wing behind No. 3 and 4 was dead. And fire worries Thomas. He knows he can bracket the

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LASNY bought a second-hand "barrel" and "cradled" her into place with a fork-lift truck.



THEY RIVETED THE "BARREL" into place—and the plane promptly went back into service.

softness caused in spars and skin by gasoline-fed flames. He works outward from the soft spots to hard skin with a hardness tester. But he never knows how far the flames have flickered along internal ducting. Nor how badly the wiring is cooked. And if the crash has triggered off lawsuits, he can't break open the plane to take a long, careful look.

He told his crew, "We'll shore up the leading edge with wood, bend some aluminum around it to complete the airfoil, and strengthen the entire section by riveting some stringers to the outside. That'll get us back to New York."

To the owners he named his price. They frowned, said, "O.K., if you can do it."

It's often a gamble—and this one almost paid off. When he was ready to fill No. 4 main gasoline tank for the test flight, he found that the fire had loosened the tank's rivets. It leaked badly.

Thomas took a deep breath. It would take several more days to unbutton the wing, disconnect the leaky tank, and install a new one. "So," he said, "we'll fly to New York without No. 4 main."

The pilot protested, "I can't keep her trimmed without any weight out there in that wing. She'll skid all the way."

"I thought of that," said Thomas. "We'll fill the right outboard tank with water."

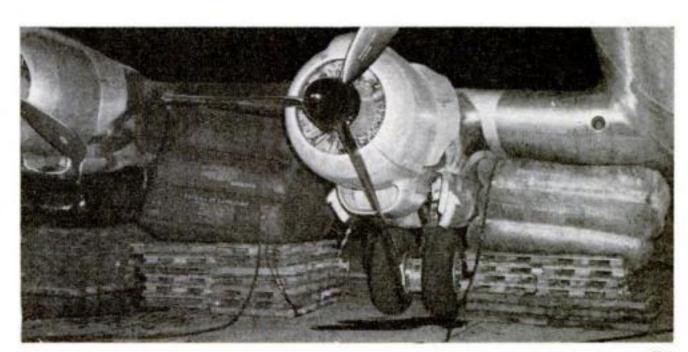
The pilot looked at him. "When we've used up the gas in the left outboard tank, the right will be full of water. Then I'll be out of trim the other way."

"I thought of that, too," said Thomas. "We'll jettison the water at the rate you use up the gas in No. 1—allowing, of course, for the difference in weight-pergallon between water and gas."

They staggered into the sky with No. 4 main leaking water all over the Brazilian landscape. The flight plan called for stops at Recife, Belem, Port of Spain, Havana and Miami.

Just as they hit the valve to jettison the first load of water, Sao Salvador radio crackled into their headsets, "079, you're on fire."

A FEW POUNDS OF AIR per square inch lifted this U.S. Navy craft high enough so that jacks could be fitted under her wings. The big danger here is slippage—plane could roll off the bags.



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Thomas leaped to the window. The spray of water drifting out behind them looked like ribbons of smoke. He laughed. "It's O.K.," he radioed.

But the big laugh was to come. When they taxied gingerly into Recife, a startled lineman ran screaming for a fire extinguisher. He pointed to the liquid dripping from No. 4 main. "Cut the switches," he yelled. "You're leaking fuel all over the ramp."

Thomas looked and shrugged. "Forget it," he said. "We're in a hurry." He stepped out. "Put in 800 gallons of water and clean the windshield."

When they finally calmed the lineman down, he said only two words: "Crazy Americanos."

An airplane is a simple thing in structure. You take an I-beam for a core and call it a spar. You lay airfoils across it and call them ribs. You sheathe with aluminum —and call the whole thing a wing. To make a fuselage, you curve some more I-beams into circles, stand them up one behind the other, and tie them together with long strips of aluminum called stringers. Then you lay this shell on top of the wing spar.

This shell-on-a-crossbar tends to tear apart at the seams if it runs into anything solid—as

into anything solid—as the pilot for a Latin-American airline found out not long ago.

Instead of flaring out his 50-ton airplane just before touch-down, he flew her straight into the asphalt.

Two of the four engines broke their mounts. Wing skin tore. And the tail fell off. In fact, the shock broke the plane's back and the last 30 feet of shell fell onto the runway.

Thomas peered at the pieces, then talked to the pilot. Says Bill Mueller, one of his assistants, "Tell Neal the temperature on the day of the crackup, the atmospheric pressure and humidity. Then tell him what weight the plane

was grossing, her speed, and the angle at which she hit. He'll tell you how many rivets popped without even looking at the wreckage."

Though this may be an exaggeration, Thomas can tell, through long practice, pretty accurately what spars will have broken and which fittings will have torn loose if the pilot clues him completely on just how the accident happened.

Bracketing the damage is his next step. When he left the Baranquilla terminal that day, he walked quickly to the wreckage, ordered the inspection ports opened and took a score of X-rays of the

wing spar and the landing-gear shock strut. When asked why he didn't inspect the fuse-lage first, he laughed. "I knew what was the matter with the fuselage—it was broken. I wanted to find out whether the gear struts had torn loose from the spar and whether the spar had cracked."

With X-rays in hand, Thomas walked to airline headquarters. Now came the toughest part of the job. The airline would gladly write off the ship for the insurance—and a new plane; but the insurance company might not be willing to do that.

If the insurance company insisted that the plane be repaired, the

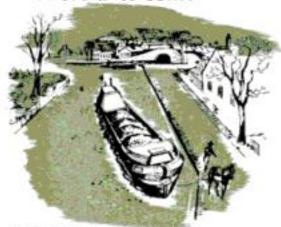
airline would want the job done at a rock-bottom price—partly, of course, to save money, but also in order to keep its insurance rates low.

There are lots of variables. He had to guess whether the airline would want to do part or all of the repair itself under his direction. He scratched his head, trying to remember whether this airline carried its hull insurance in pesos or dollars and what the prevailing rate of exchange was.

And all the time, little lights were blinking on in his mind like a Univac digesting a thousand digits: How much would it cost to buy and ship in that

[Continued on page 198]

Where'd it come from?

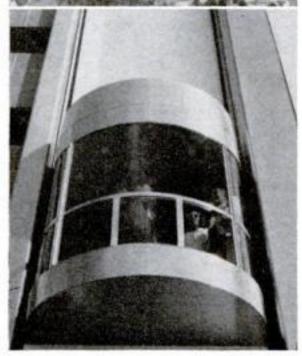


BARGE: Maybe you thought it was just a flat-bottomed boat for transporting goods. Originally it meant the boat's exact load: 21.2 long tons. (A long ton is 2,240 pounds.) That same "barge" measure is called a keel when shipping coal. You know, "Carrying keels to Newcastle." (All right, "coals"—but the words bespeak a common heritage.)

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PS Picture News





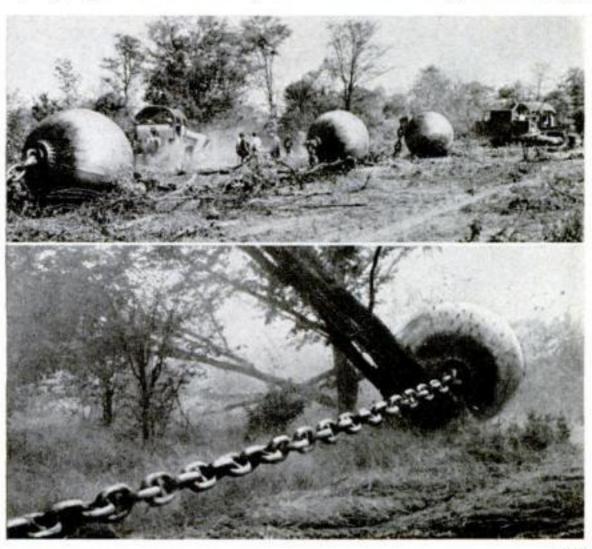
VIEW LIFT. The elevator above runs outside the Saxony Hotel in Miami Beach to its night club on the fourteenth floor. The swank car takes on 33 passengers at the lobby, whisks them to the top without a stop. It is air-conditioned, carpeted, has dimmed lights.

TREE UPROOTERS.

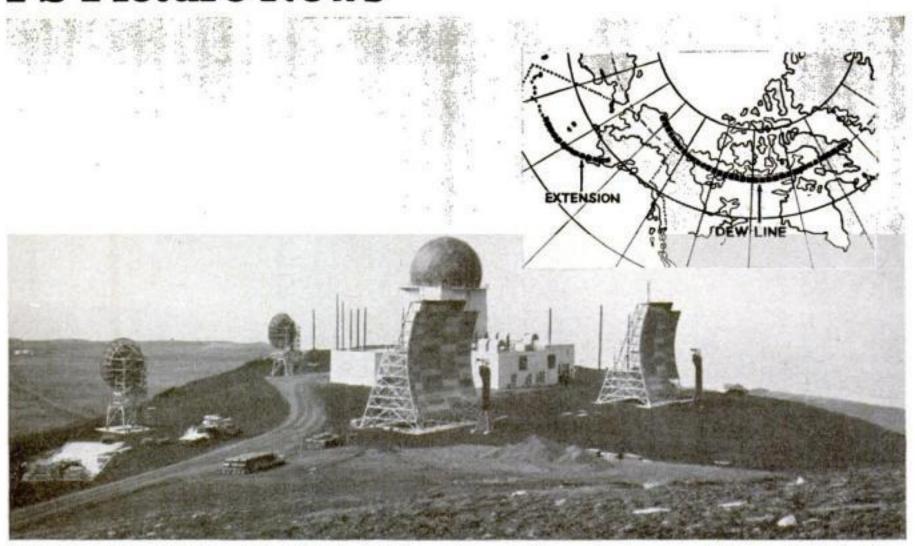
The three huge eight-foot steel balls at right, strung on anchor chains and pulled by tractors (top), were used to clear 100,000 acres of tough African bushland for a hydroelectric power site in Rhodesia. The big balls are honeycombed for maneuverability, strength.



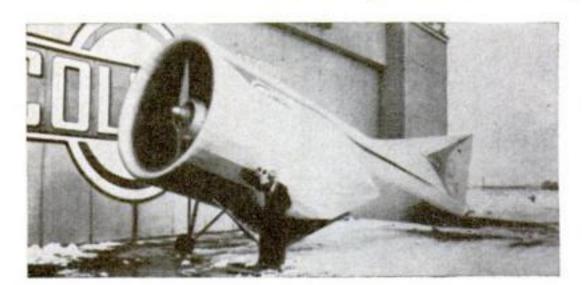
RADAR TOP. The radome over the cockpit of the Bell RH-2 research helicopter at top covers the radar antenna in the lower photo. It's an obstacle sensor that equips the whirlybird for all-weather instrument flying—part of a new system for the Army and Navy.



PS Picture News



DEW LINE EXTENSION. This radar station atop rugged Cape Sarichef on Unimak Island is one of six erected in the Aleutians to prevent enemy end runs around our Distant Early Warning Line across Alaska and Canada (inset map). Stations are spotted at intervals of 100 miles.



full-scale model of the wingless Aerodyne (left), U. S. version of France's Coleoptere (PS, June '59). It was designed by Dr. Alexander Lippisch for vertical takeoff and landing, is being made by Collins Radio Co. for the Army and Navy. Two contrarotating props in the fuselage pull air through.



FIBERGLASS TRUCKS. To reduce over-the-road weight, two leading truck builders have now gone into fiberglass. The White (left) has a complete fiberglass cab that tilts forward; the Kenworth has fiberglass hood and fenders that also tilt and are light enough to be entirely removed.



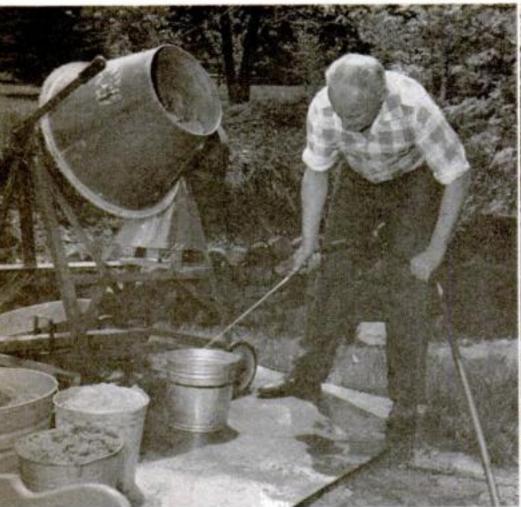
That Wonderful Cement Mixer of Mine By Henry B. Comstock

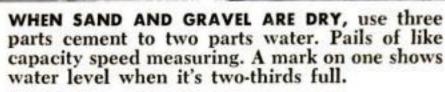
IGHTEEN years ago a building contractor left me with a raw clay slope that let go every time it rained. It plopped into window wells and did a wall-to-wall carpeting job on the basement floor. That, indirectly, is why I'm now the proud owner of a $2\frac{1}{4}$ -cubic-foot cement mixer.

You would hardly call it an impulse

buy. Between 1941 and 1958 I worked stubbornly with a mortar box and hoe, whipping up concrete to tame and land-scape the unruly grade. Over the years, I kept finding new uses for the wonderful stuff that hardens into stone overnight. But there was one hitch. Folding cement into sand and gravel by hand is a chore that grows no easier with experi-

Here's the way a pro told me to charge the bucket







WITH MIXER RUNNING, dump in the water. Then add a couple of scoops of gravel. This sets up a scouring action that will prevent caking of cement on the drum interior and blades.

ence. So last spring I threw in the hoe. The rig I bought had nothing flossy about it. It came with a hand crank and a wheel-less chassis. But the manufacturer had thoughtfully spotted holes for a power platform, and tossed in a pulley and belt guard. The accompanying dope sheet recommended a ½-hp. electric motor or a 2½-hp. gas engine.

With some misgivings I harnessed up a quarter-horse job scrounged from a 1934 washing machine. I needn't have worried. Either the motor was feeling its volts again, or the instructions were over-cautious. When I turned on the juice and tried to stop the drum by hand, I was lifted off my feet and nearly judoed over it. Listening to the businesslike rumble of the ring gear, amplified by the empty barrel, I had a feeling the mixer and I were going to get along fine.

Two hours later I wasn't so sure. By then I knew I had goofed when I settled for a stationary model rather than a handportable one. There are only two ways to move one of these comparatively light but bulky and top-heavy machines. One is to con a neighbor into helping you carry it—a shin-splintering operation that will find him behind closed shutters next time he sees you breaking camp. The

other is to improvise some sort of twowheeled underframe.

The lack of wheels was double trouble. Before I got around to adding them, I set up the mixer some distance from a work site. Flipping the drum experimentally, I found that in full-dumping position it wouldn't clear my wheelbarrow, or even the large wash tub I often use to skate mortar and concrete to inconvenient working locations. I'd have to plop the "mud" onto a ground-level platform and relay it from there.

Since then I've learned that this holds true of most small mixers, and with some reason. If the bucket is placed for barrow loading, it's much too high when you tilt it back for shovel or pail loading and mixing. That's why big contractor-type rigs are generally charged from a ramp.

As a compromise, I boosted my mixer onto four cinder blocks. That would let me dump directly into the tub, and still keep the upturned bucket within reasonable feeding height. I made a mental note to build my wheeled underframe 8" high, to get the same clearance.

What about formulas, now that I was ready to let the machine take over? For years I'd been proud of my ability to squirt just the right amount of water into

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. for the fastest and most accurate concrete mixing



NEXT, CHARGE THE DRUM with one pail of cement for each measure of water. Finish with enough aggregate (that's sand and gravel), to give you the kind of concrete mix you want.

FOUR MINUTES OF TUMBLING is enough to blend most batches thoroughly. A good formula for the majority of jobs is one part cement, two

parts sand, four parts medium-fine gravel.

the dry makings of a stiff troweling mortar or a more plastic pouring mix. No measuring—just intuitive timing with the hose. But this was going to be different: smaller batches, poorer visibility, less evaporation. And which should come first when I loaded the drum—the water, sand and gravel, or cement?

I called up a contractor friend, and he gave me the official etiquette. I followed his instructions and in a matter of minutes had a relatively small batch ready for a footing form.

Next time, I doubled the formula. There was plenty of room for it. The water went in fine; so did a couple of scoops of gravel. But when I followed with a slug of cement, the stuff jelled in a brief half-turn around the drum, fell heavily into the whirlpool again—and shot back in my face with the explosive force of a Mack Sennett pie.

As soon as I had flushed it off and dunked my eyes in boric acid, I inspected the stop bolt on the mixer's handle. By loosening and moving it forward in an arced slot, I could adjust the drum to work at a higher feeding angle. I overdid this on the first try; too much of the charge stayed at the back of the bowl, where the blades couldn't slice away at



SMALL BATCHES OF MORTAR are as easily mixed as concrete. Here it's simplest to use special mortar cement, with from five to six parts sand and just enough water for a stiff batter.

it. But a bit more juggling gave me the fairly critical angle needed to mix a heavy load thoroughly. I indexed the setting with a scratch mark. I added another, some time later, when I had to readjust the angle to handle smaller batches of

Protection for yourself and the mixer



MUD WASPS like to build nests in mixer drums and may give you a hard time when you start the motor. Between jobs, plug the mouth with netting and flip the bucket to dump position.



A GREASE GUN is practically indispensable for lubing drum spindle and pinion-shaft bearings. Special guns using lithium cartridges are easiest and least messy to load.

Mixer-cleaning trick

Toughest chore, when you're through for the day, is removing the "mud" from the blades in the drum. Try this: Throw in a pail or two of water, a shovel of coarse gravel and a dozen or so small stones. Run the mixer while you clean the other tools. The stones will dislodge the heavy deposits and the gravel finishes up the job. A word of caution, though: Don't use stones any larger than your fist or they may dent the drum or bend the blades.

mortar. This way I can make a quick changeover.

That was the end of my troubles with the mixer. Last year, the two of us didn't quite finish a swimming pool. But there were interruptions: whipping up mortar for an outside entrance to a new storage area under the porch and walling in part of an old garage doorway for a picture window.

No task is too large or too small for the tireless little rig. Take the pool, for example. Normally it would have made sense to use ready-mix. But no truck could have pulled within sluicing distance of this particular hill site. With the mixer I was able to set up 40 tons of side walls in 10 weekends.

When it came to pouring the rough underfloor, I contracted for a day's help from three robust relatives who, I figured, would benefit as much by the finished project as I would. I thought of renting a second mixer so we could work in teams. But as it turned out, mine was more than a match for our combined charging and dumping efforts. Between sunup and sundown she churned out 3½ cubic yards of coarse mud for the 6″-thick slab.

Loving care for the mixer comes naturally after service like this and I reward mine by treating it with consideration. At the end of each work session, I scrub it out thoroughly. This takes stern selfdiscipline, when muscles are knotting and supper is carbonizing on the kitchen stove. But the one time I neglected it was enough. A cement bucket is the next thing to a solar oven when you put your head inside to chip away a couple of pounds of cured concrete.

Lubing is another chore I take seriously. I bought a small Alemite gun to handle the drum spindle and pinion-shaft bearings. As for the ring gear and pinion, there are two schools of thought about applying grease to their teeth. One says: "Don't—the stuff simply attracts and holds sand and fine gravel, making teeth wear out faster."

My contractor friend disagrees. He tells me he's tried both ways, and heartily recommends an occasional dose of lithium grease, after cleaning out any accumulated grit. I go along with him. That wonderful cement mixer of mine deserves nothing but the best.



Short Cuts and Tips

FROM PS READERS

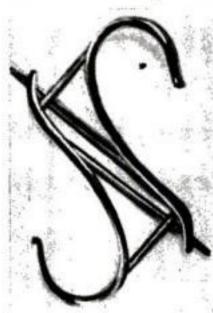
Automatic Gate for Electric Fence

A FARMER I know who has an electric fence put a gate on it that never needs to be opened or closed.

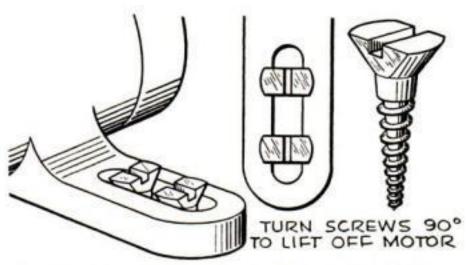
He fastened screen-door springs between the gate posts at each end of the wire, which is set near the ground. When wheels pass over, the springs give and then snap back into place.—
Kenneth Imig, Watseka, Ill.

How to Improvise an S Hook

SCREEN DOOR SPRINGS



When I needed an S hook to hold a pail while painting, I made one out of two wire coat hooks by pressing the screws through the outer loops. Arranged this way, the more weight put on them, the tighter they lock.—Charles F. Rehm, Sheboygan, Wis.



Portably Mounted Shop Motor

When you mount a motor that you may have to move once in a while for use in another part of the shop, it's a good idea to file the mounting-screw heads flat on two sides.

Then all you need do is turn them 90 degrees and they will clear the slots so that you can lift the motor from its base.

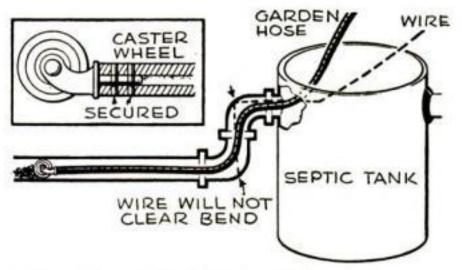
—Jack Crockett, Nuevo, Cal.

Cookie Cutter Marks Corners

A CIRCULAR cookie cutter will work fine when you want to mark off a piece of stock for cutting the corners round.

The knob provides you with a firm hold, minimizing the chance of a slip while you are laying out curves.—Donald Spichuk, Brooklyn, N.Y.

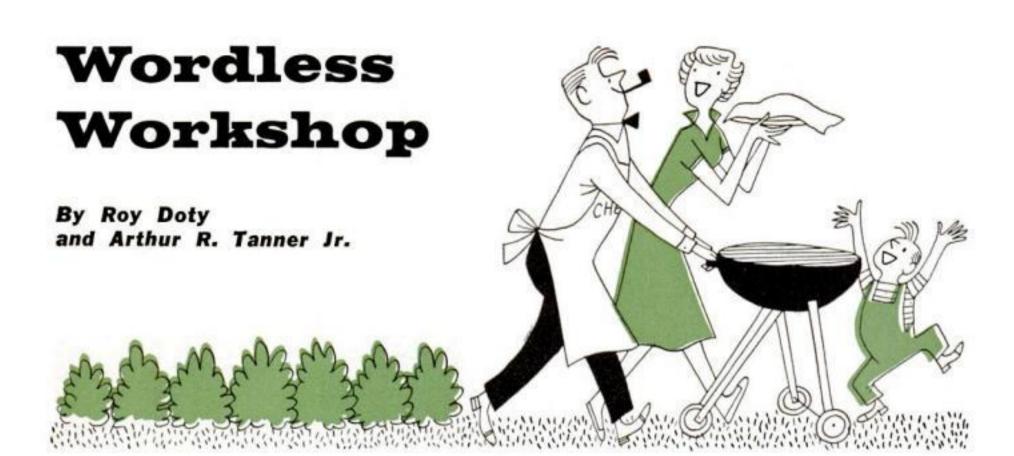




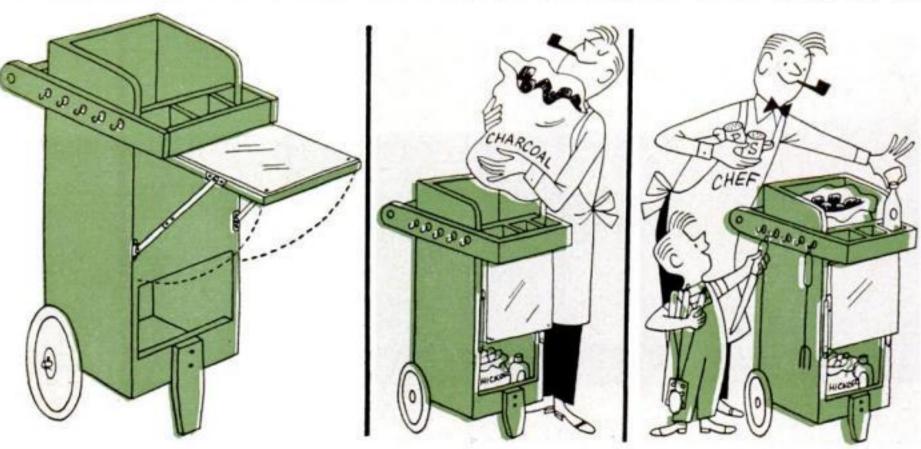
Clearing Out Drain Elbows

When I found a wire wouldn't pass a bend in the drainage line to my septic tank, I clamped a caster into one end of a length of discarded plastic hose. Put through the drain opening, it rolled past elbows and over ridges effortlessly. I pushed it in and out a few times to clear sludge and solids. It didn't kink once.

—John Franklin, Frenchmans Bay, Canada.

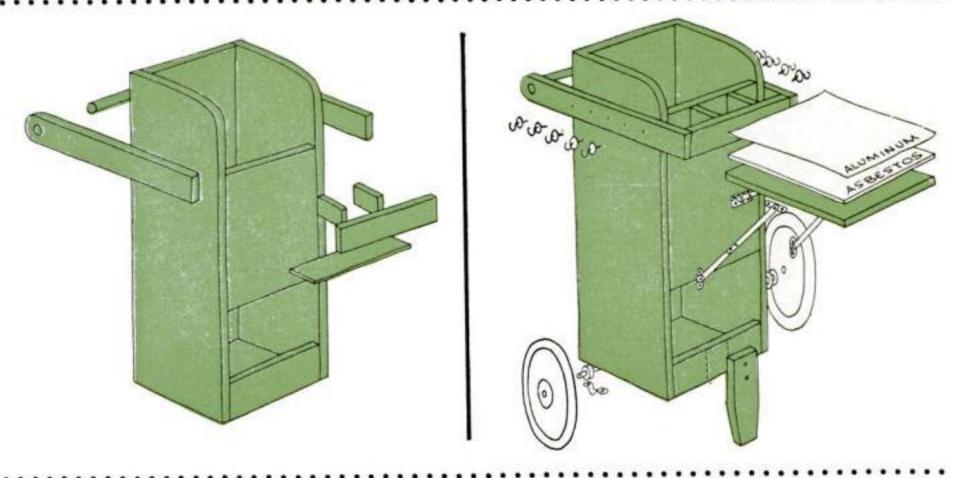


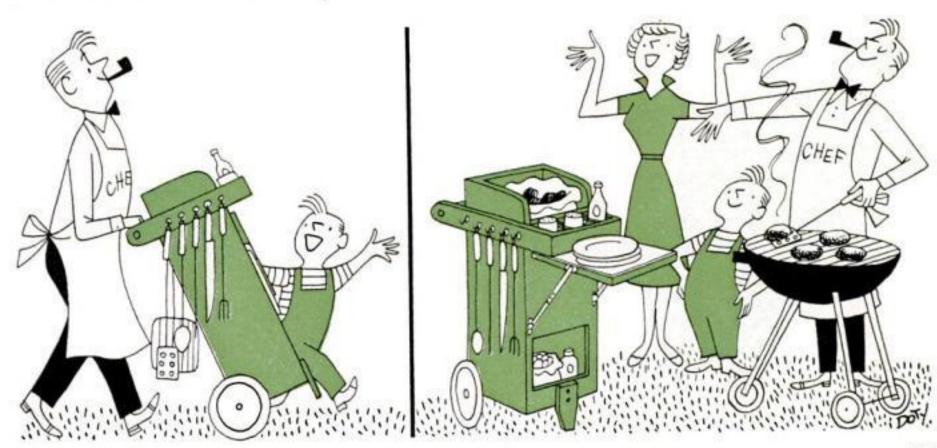




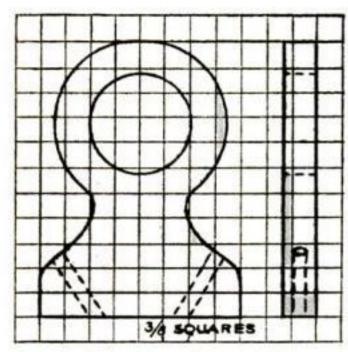
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Short Cuts and Tips





Individually Styled Brackets Support Curtain Poles

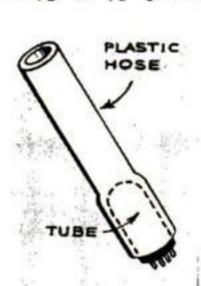
You can design your own curtain-rod brackets from ½" walnut, oak, maple, mahogany or other hardwood scraps to match your furniture or room woodwork.

Trace the pattern on the stock and cut with a saber or coping saw. You may have to stain the poles—they are usually oak.

—Scott J. Saunders, Plainview, N.Y.

Removing Radio and TV Tubes

You can make a tool that handles miniature radio and TV tubes with a length of \(\frac{1}{2}''\) or \(\frac{5}{8}''\) plastic hose. Press an end of



the hose over a tube when the set is hot. Then turn the set off and, when the tubes cool, take off the hose. The heat will reset the plastic so it will grip tubes for removal or insertion in hard-to-get-at places.—A. E. Bryant, Lynchburg, Va.

Dressing Up Medicine Cabinet

One way to keep a bathroom medicine cabinet looking uncluttered is to arrange toothpaste and other tubes neatly

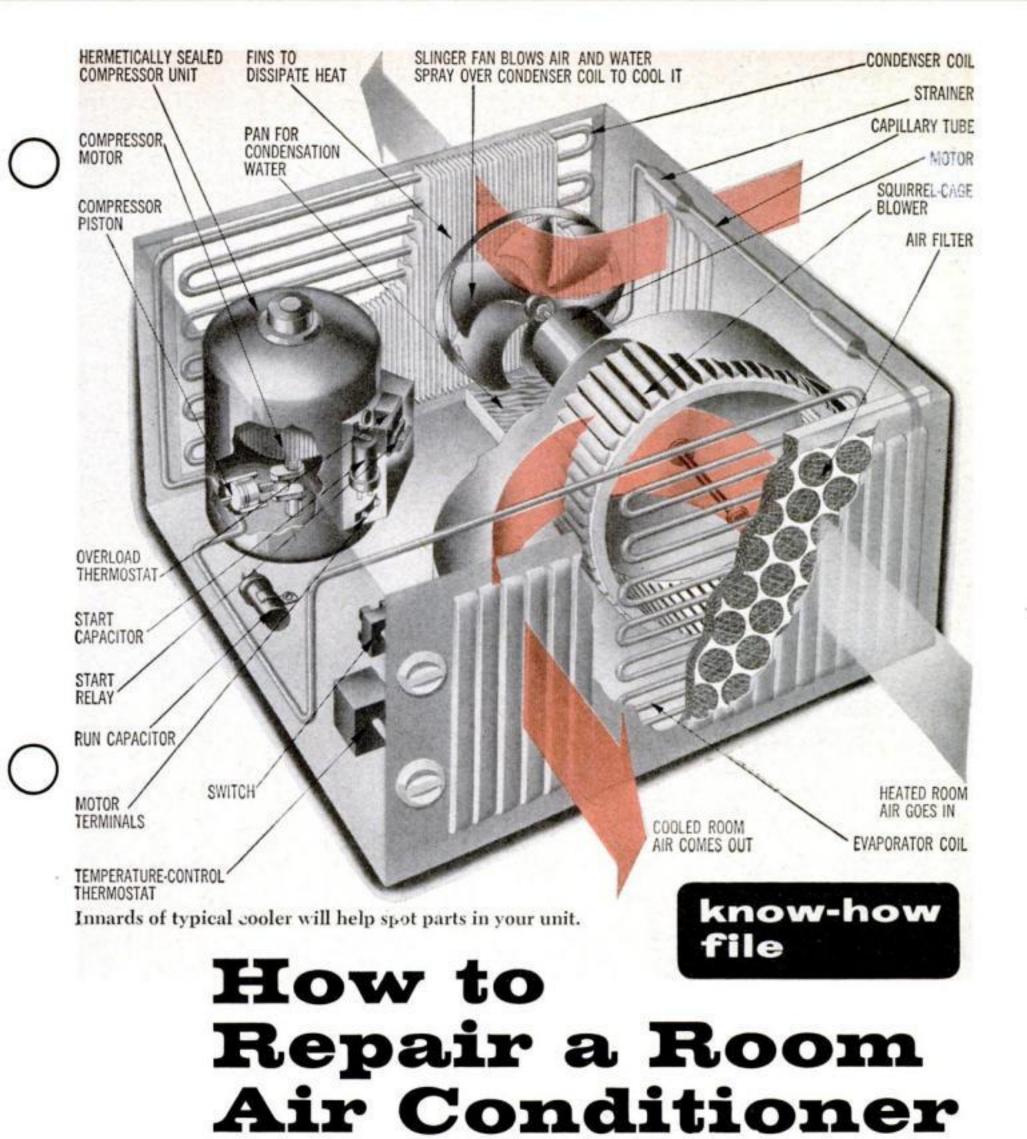
on the back and side walls. You can do it with small nails and spring clips. Hold tubes by the bottom end—one clip will take two if you have a lot of them. Hang the most frequently used at the front.—

Barbara Nicholson, Park Ridge, N.J.



New Index of PS How-to-Do-It Articles Is Now Ready DO YOU file away each issue of Popular Science Monthly? Would you like to be able to refer with ease to articles of particular interest?

You can do so with a new index. It covers all items that have appeared in the Mechanics & Handicraft section for the past year, from July, 1958, through June, 1959. To get the Index, send 10 cents in coin or stamps for handling and postage to Index Editor, Popular Science Monthly, 355 Lexington Ave., New York 17, N. Y.



THEN a room air conditioner conks out, first thing you ought to know is what you should not do. There is a lot you can do yourself, but it's usually best to call in a serviceman if—

 The sealed compressor unit breaks down, or

 You find a leak in the refrigerant lines.

As with any machinery, you have a

THEN a room air conditioner better chance of repairing an air conditioner tioner if you know how one works.

An air conditioner operates on the same principle as a refrigerator. A liquid that boils at a temperature well below zero degrees—usually Freon 12 or 22—is the secret. As it changes from a liquid to a gas, it absorbs heat. And when the gas changes back to a liquid, it releases heat.

To put this principle to work, your room unit pumps the liquid refrigerant through a narrow tube called a capillary. This reduces the refrigerant pressure and it vaporizes as it passes through an evaporator coil on the room side of the unit, extracting the heat from the hot room air.

The hot low-pressure gas is pulled into a motor-driven compressor where the pressure is increased. The hot high-pressure gas is then pumped into the condenser coil on the rear of the unit. In this coil, the gas is cooled sufficiently to change it back into a liquid, and, in so doing, it gives up its heat outside.

The refrigerant then goes back to the capillary tube to start the cycle all over again.

A motor with a fan on both ends helps along the hot-air transfer. The fan on the room side pulls hot room air through a dust filter and evaporator coil and recirculates the cooled air back into the room. The other fan slings out the moisture that drips from the evaporator, helping to cool and liquefy the hot refrigerant and reduce room humidity.

The units that both cool in summer and heat in winter work the same way, but have a thermostatically controlled valve that reverses the flow of the refrigerant through the coils. In cold weather, it removes heat from outside and releases it in the room. Some units are also equipped with electric resistance heaters to help on a very cold day.

Consult the chart to know where typical troubles lie. In many cases a symptom may mean more than one trouble. Here is how to start.

The sneaky little troubles listed in the "general" section of the chart may seem so obvious they may be overlooked. Eliminate these first.

The electrical system is the next suspect when general checks don't spot the culprit.

Make up a tester as shown. With it

						ME	CH	ANI	CAL	32			
Room Air Conditioner Trouble Shooting Chart	CAUSES ▼	Filter dirty	Coils blocked or dirty, fins bent	Room thermostat set too high	Damper improperly set	Blower loose on shaft	Fan loose on shaft	Low outdoor temperature	Unit not level	Compressor mounts defective	Temperature-control dial set for continuous run	Unit too small	Damper, damper dial or control rods bent or binding
SYMPTOMS ▼ Poor cooling (or heating*), compressor a	nd							7000					
fan running No cooling (or heating*), compressor not running		•		0									
Compressor won't start, fan motor runs		-											
Fan and compressor won't run													- 113
Fan motor won't start, compressor runs													
Compressor operates continuously						July 1		10					
Insufficient air volume		•			•								
Compressor cycle short, fan motor runnin	g	•				•	•						
Blown fuses													GIN
Fan motor runs intermittently, compressoruns	r												
Unit noisy, or excessive air noise							•						
Condensation water overflows													
Excessive frosting of evaporator coils		•						•			•		
Control dials hard to operate											113		

How to stop troubles with room coolers before they begin

PREVENTIVE maintenance is the most profitable "trouble-shooting" time you can spend on your air conditioner. A good time to begin is when you start up your unit after the winter.

 Lubricate the fan motor with No. 20 oil (on those motors requiring oil) every year in northern climates, every six months in hot regions or if you are a year-round user.

 Inspect the air filter at least once a month, following the maker's instructions for cleaning. Check for clogged condensation drain lines twice a season at least.

 Test the fan and blower wheels yearly for alignment and possible slippage on the shaft. Wipe off oil, lint and dirt.

 Look at the coils monthly. Brush off dirt and straighten any bent fins.

 Trim off vines or shrubs that grow high in front of the condenser coil.

• In the fall, store the unit in a dry place, or protect the outside with a tightfitting cover to keep out freezing snow and rain.

you can check out nearly every part. It indicates when there is a flow of current through a circuit. Use it as in the photos, with or without the power applied.

Room units are generally wired to

allow the fan to operate independently to circulate room air without cooling (some models have two separate motors).

Compressor operation is usually governed by a thermostat. When room tem-

		ğ												
	Reversing-valve defective*	•					•							
RAI	Moisture in system						•		•					
IGE	Restrictions in refrigerant lines	•							•					
EFR	Low refrigerant charge or loss of charge	•		5			•						•	
R	Compressor defective	•	•	•			•							
1	Electric heaters defective*	•	•							•		•		
	Reversing-valve solenoid defective*						•			•				
	Low line voltage	•							•	•				
	Fan motor defective, motor "run" capacitor grounded					•		•	•	•	•	•		
L	Compressor motor defective			•					•	•				
ICA	Compressor-overload thermostat defective		•	•					•	•				
CTR	Compressor starting relay defective		•	•						0				
ELE	Compressor motor "run" capacitor defective		•						•	•				
1	Compressor motor "start" capacitor defective		•	•						•				
	Loose connections, open circuits		•	•			•		•	0				
	Temperature-control thermostat defective	3.0	•				•		•				•	
	Incorrect fan speed								•				•	
	Fuse blown, switch "off" or defective		•		•									

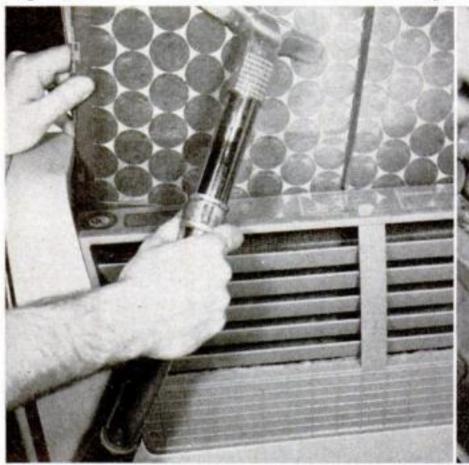
perature rises, the thermostat switch applies power to the compressor-starting relay, which temporarily allows a high current to bypass the running capacitor. This creates the high torque required to start the hefty compressor motor. When a proper voltage appears across the relay coil, its starting contacts open and the running capacitor and running-motor winding take over.

A bimetal overload thermostat is connected in the compressor circuit to cut off the power should the compressor become overheated in starting or running.

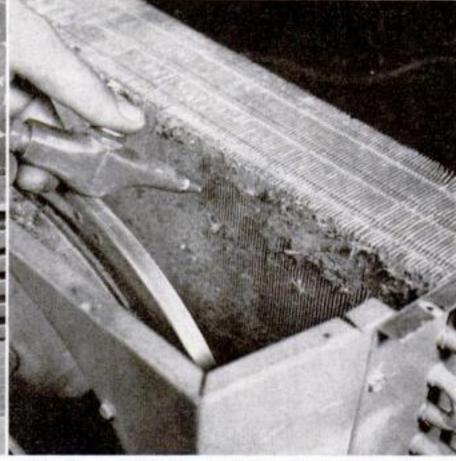
Check visible troubles like fuses, loose or broken wires, or visibly damaged parts first. Compare the typical circuit diagram with that of your unit. You may find this glued to the cabinet interior or in the owner's manual. If not, write the maker for one. Pay heed to his color code to make wire tracing easy.

Low line voltage can cause hot motors, erratic operation, poor cooling and blown fuses. Eventually, it can knock out the unit. You can be reasonably sure line voltage is adequate if the unit has performed normally in the past and if the distance from the outlet to unit does not exceed the maker's recommendation. Be sure that your house wiring is adequate for the load and that no heaters or major

Operation 1: Correct these simple mechanical faults first



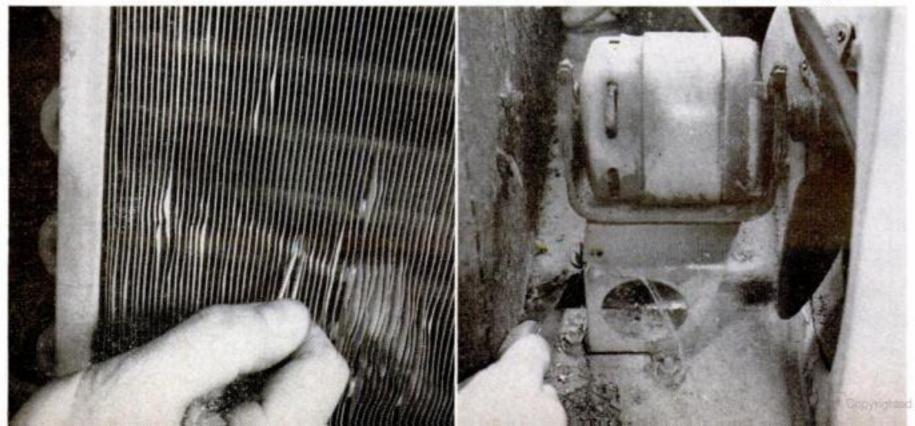
cause a conditioner to run itself ragged. Check them once a month; follow the maker's instructions for cleaning your particular type.



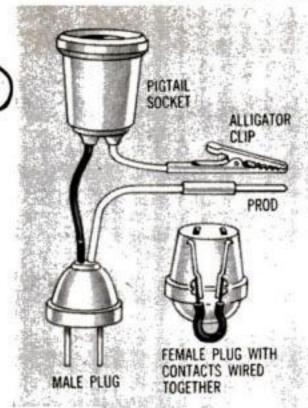
DIRTY CONDENSER COILS are best cleaned with an air hose or vacuum cleaner. To keep dirt out of the unit, blow from inside out. If necessary, use a brush carefully on the fins.

BENT FINS on condenser or evaporator strangle efficiency; lead to other troubles. Straighten them with a U-shaped wire, slid gently up and down. Make sure you don't scratch the coils.

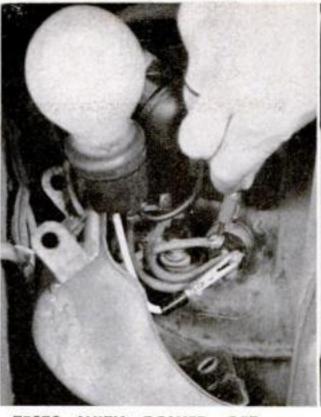
CONDENSATION WATER must run freely from the evaporator coil to pan for the slinger fan. Clean dirt and debris from the trough. Coat any rust spots with a rust-preventive paint.



Operation 2: Now you're ready to tackle electrical failures



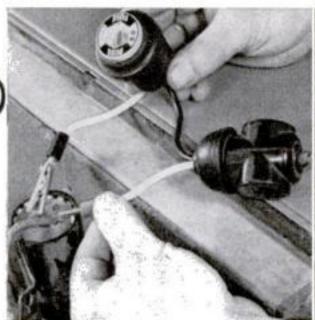
HOMEMADE TESTER checks shorts, opens and grounds quickly. Make it from a rubber-covered pigtail socket wired as shown to a plug, prod and clip. Female plug with its contacts wired together lets you shunt male plug for "power-on" tests. Use a 25-watt bulb in the socket.



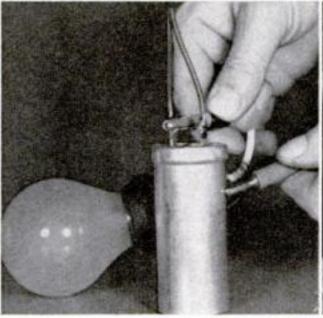
made with tester plugged into 115-volt extension cord. Here, compressor-overload thermostat is checked for open circuit. If bulb lights with clip and prod on contacts, continuity through circuit is okay. Don't touch both the clip and prod at same time.



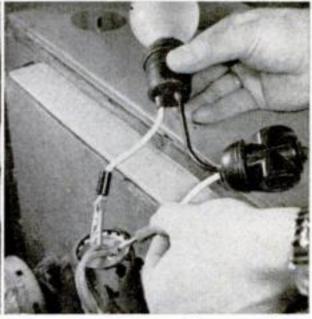
TESTS WITH POWER ON are made with tester plugged into special shunted plug, and current comes from machine itself instead of extension cord. Here, a switch is checked for continuity. If bulb lights, switch is okay and trouble is elsewhere. If it doesn't, switch is bad.



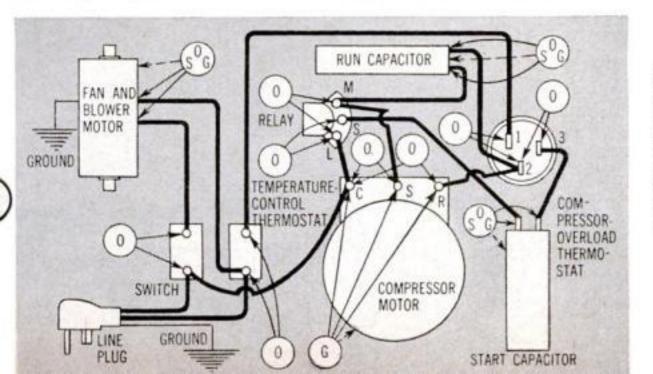
test for shorts in capacitors by substituting a 10-amp fuse for the bulb and plugging tester into 115-volt line. If fuse blows as prod and clip touch capacitor's terminals, capacitor is shorted and must be replaced. Caution: first unplug unit and discharge capacitor.



rest for grounds on metalcased capacitors next. With bulb in socket and tester plugged into line, touch the prod and clip between capacitor's case and its terminals. If bulb lights, capacitor is grounded to its case and must be replaced with another of the same type.



test for opens in capacitors by using tester plugged into 115-volt line in same way as for grounds. Bulb should light when clip and prod are placed on capacitor's two terminals. If it doesn't, no current is getting through the capacitor and you will have to replace it.

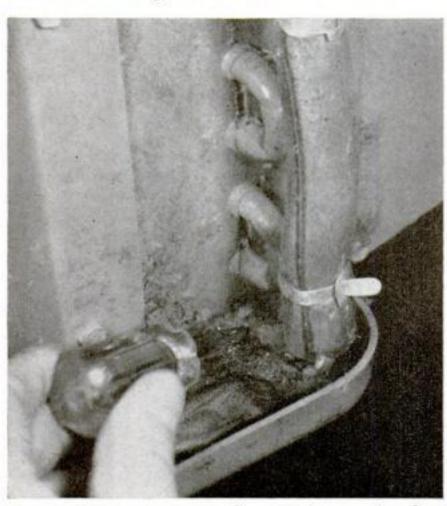


is marked "O," "S" and "G" to indicate where to make tests for opens, shorts and grounds. Hook up the tester as shown above for each type of check. Because circuits vary, be sure to check these trouble spots against your own wiring diagram, too.

appliances are plugged into the same circuit. Then check the components where trouble is indicated, like this:

Fan motor. Check for free shaft rotation. If a fuse has been blown, test for shorts across the motor terminals first, with the power off. If no fuse has blown, test with the unit turned on for voltage at the motor terminals. If the motor is shorted or won't run, it must be replaced or rebuilt.

When the test light indicates no power at the motor, trace the circuit to the switch. Power into, but not out of, the switch means you have a bad switch.



GAS LEAKS ARE SNEAKY because Freon is colorless and odorless. But oil in the coils can be a giveaway. If you suspect a leak, check all tube joints for oil deposits or bubbles.

If the fan motor is of the capacitor type, test for grounding, as shown in the photos. When the compressor is the suspect, check in this manner:

Room-temperature thermostat. Adjust temperature dial to the coldest setting. With power off, test for a possible open circuit across the terminals. If the bulb fails to light, replace the thermostat.

Compressor capacitors. For safety, discharge the capacitor by shorting across the terminals with the shaft of an insulated screwdriver. Then remove the wires and check as shown in the photos. (Some models have only one capacitor).

Compressor-overload thermostat. The thermostat must be cool to the touch before testing. With power off, remove

the wires and test for possible open circuits between No. 2 and No. 1 terminals and between No. 2 and No. 3 terminals. If the bulb fails to light in either case, replace the part. On two-terminal thermostats, make a single test.

Compressor motor. With power off, remove the three leads from the terminal block and test for shorts as shown on the wiring diagram. Scratch paint off the housing to get a good ground and test all three terminals for possible grounds. Then test for possible opens in both starting and running windings. If the unit fails any test here, have a serviceman verify your findings.

The compressor-starting relay (some models don't have one) is a bit difficult to check. If all other components check out, on three-terminal relays disconnect the wires. Place the tester clip on the common or "L" terminal. If the bulb does not light when the prod is touched to each of the other two terminals, it is safe to assume that the relay is bad and must be replaced.

Resistance heaters that fail to heat on year-around models should be checked for shorts and open circuits and replaced if the thermostat switches that control them check out okay.

Reversing-valve solenoids are prime suspects on year-around models when the system remains in the cooling cycle. Check for a possible open in the solenoid and for voltage at the terminals. Shorts are hard to identify. A serviceman can verify the trouble and replace the unit if necessary.

Refrigerant troubles in the form of leaks can often be spotted by examining all connections and brazed joints. Hold your ear close to the capillary tube to detect partial restrictions. The normal "gurgle" will be replaced by a "hiss."

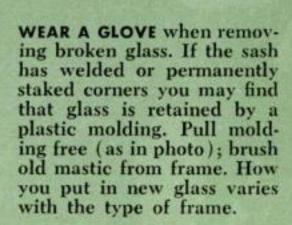
A partially plugged refrigerant strainer can be suspected when the inlet feels considerably warmer to the touch than does the outlet.

Little or no noise in the capillary, little or no room cooling and a condenser coil cool to the touch usually mean bad or broken compressor valves.

Because it is necessary to recharge and seal the system carefully whenever a portion of the refrigerant circuit is replaced or removed for service, gas troubles are jobs for a serviceman.

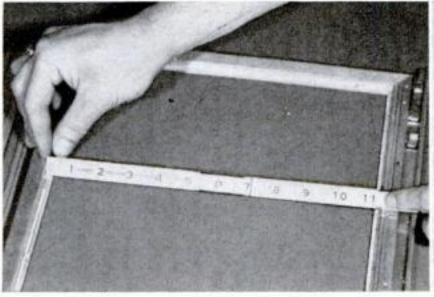
Replacing Glass in Metal Sash

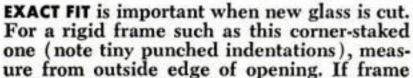


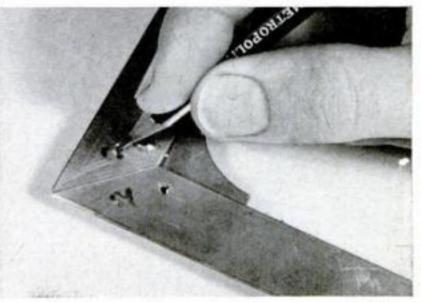




Measuring for new glass and marking the frames

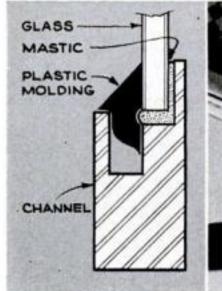


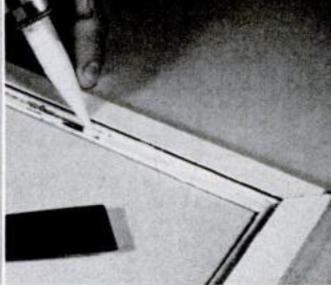


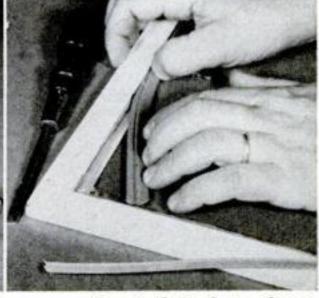


comes apart, it's easiest to measure first. Sometimes old glass can be measured. Before taking apart a frame, mark corners (above) for matching them in later reassembly.

What to do when frames don't come apart

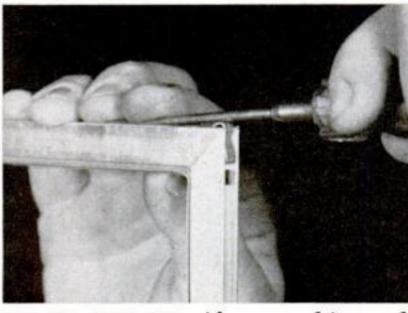




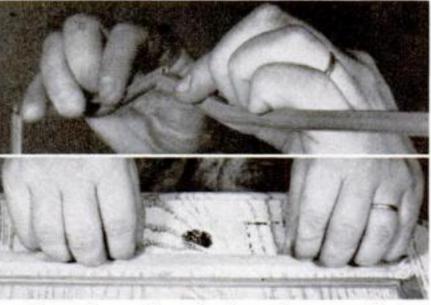


A PLASTIC MOLDING such as you see in use here is a common means of holding the glass in a metal frame, although you'll also find putty and glazing compound used. After frame has been brushed clean, apply a bed of glazing compound as in left photo above. The glass will smooth out mastic when pressed into frame. Then push plastic molding strips into groove as at right. Use new molding if old strips have deteriorated.

What to do when clips retain come-apart frames



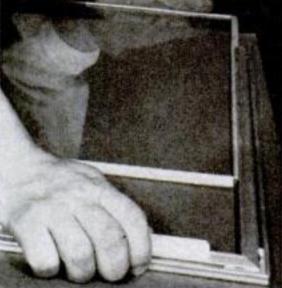
POP THE CLIPS OFF with a screwdriver and dismantle four sides of frame. Then, if window is so equipped, wrap rubber molding around new pane. Push one section of frame

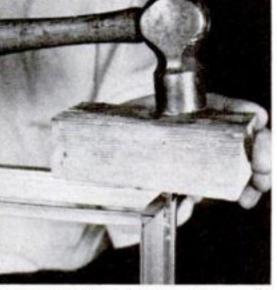


channel on edge of glass, then an adjacent channel as in lower photo above. Attach corner clip, and proceed to other sides. Reshape clips if they are bent in removal.

How to work on the knock-apart sashes



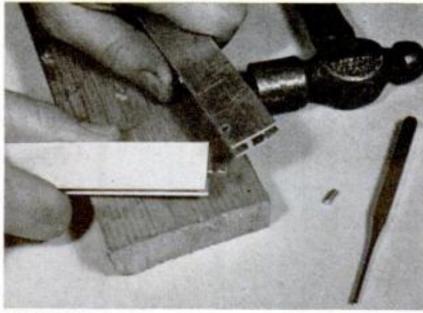




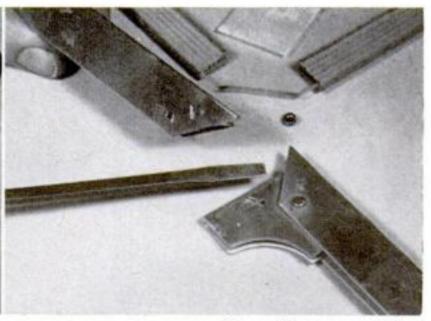
L-SHAPED CORNER RETAINERS mean knocking out one side of frame. If retainer is exposed (left), drive it out with a blunt punch. If hidden, hammer against inside edge of channel, using a wood block. Then, put molding

on new glass and slide into frame (center). Start retainers into their grooves and gently seat the channel with alternate taps at both ends. If frame feels loose around glass, centerpunch indentations at corners.

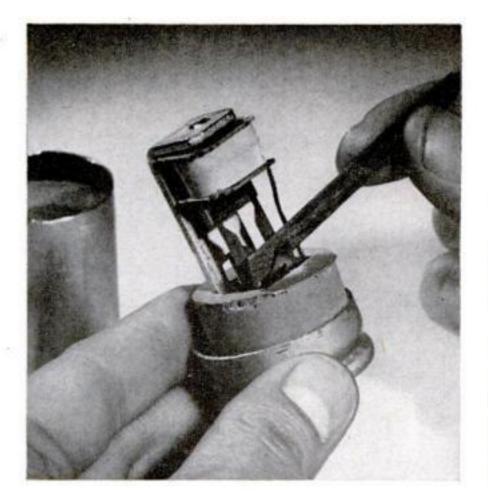
Hints about frames held by rivets or screws



IF CORNERS ARE RIVETED as above, remove channel from one edge by punching out rivets on two corners. Examine rivets first and punch out from small end. Install glass as shown for the knock-apart frames above.



sheet metal screws allow all corners of this type to be taken apart. Note how corners of new glass must be coped to keep screws from breaking it. Apply mastic inside corner gussets before inserting the new glass.

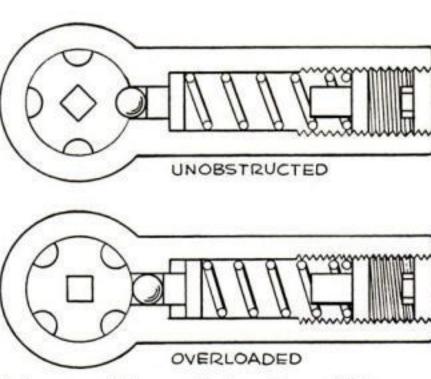


Short Cuts and Tips FROM PS READERS

Repairing Radio Vibrator

I have learned through long experience as a repairman of auto radios that the replacement most commonly needed is the vibrator.

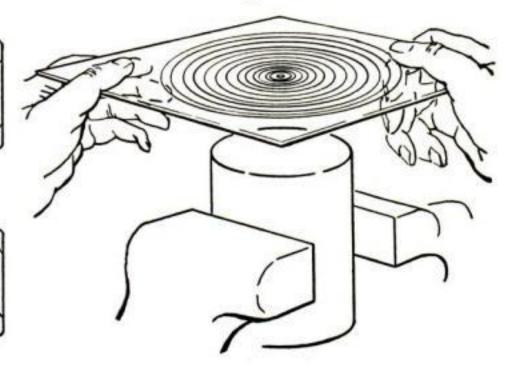
This can frequently be salvaged. Saw carefully through the shell and lift off the cover so as to get to the contact points for filing and sanding lightly. Then tape the cover back in place. Be sure not to let the blade penetrate so deep that it cuts the points.—Joseph Currier, Aspen, Col.



Torque Wrench for Small Taps

To avoid overloading and breaking small taps, I made a wrench with springloaded hollow handles. Ball bearings are pushed by the springs into dimples in the edge of a round chuck. If a tap hits an obstruction, they press back into the sleeve and tension is removed. Torque limit is adjusted by threaded plugs.—

Federico Strasser, Santiago, Chile.



Finding the Center of a Hole

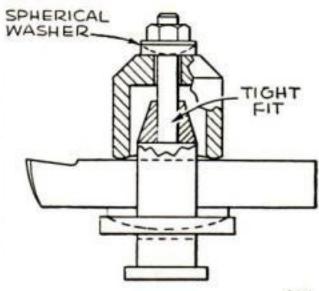
Locating the center of a drilled hole, or round stock, is easy with this tool. You can make it by drawing concentric circles on a 5"-by-5" sheet of clear plastic. Scratch the circles \(^{1}\gamma''\) apart with dividers. Match the outline of one of them with the rim of the hole, and you will be able to spot its center automatically.—

Peter Barna, Wilmington, Cal.

Rigid Tool Clamp for Heavy Cuts in Lathe

Heavy cuts in the lathe are likely to deflect the tool because of the distance of the point from the center of clamping pressure. You can avoid this with a sleeve that applies the pressure closer to the tool's point and near the ends of the rocker base.

Replace the tool-post screw with a tight-fitting stud made from heat-treated alloy steel, but leave plenty of clearance in the sleeve so it will allow space for angular setting of the tool. Use a spherical washer under the clamping nut.—F. Murray, Chicago.



1 while you're rolling along the road, the tent and platform rest atop the boat.



For real convenience and carefree weekends, you're sure to like

The Tent That Rides on a Boat

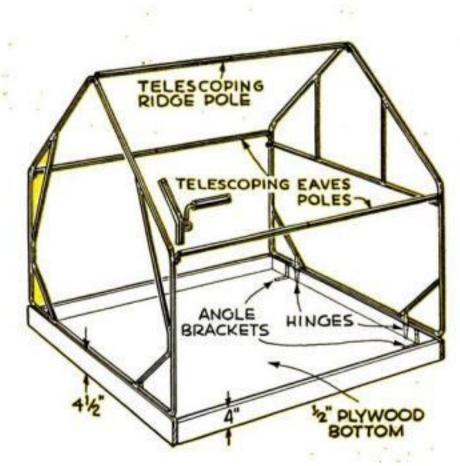
By Gordon F. Manning

HIS could be you:

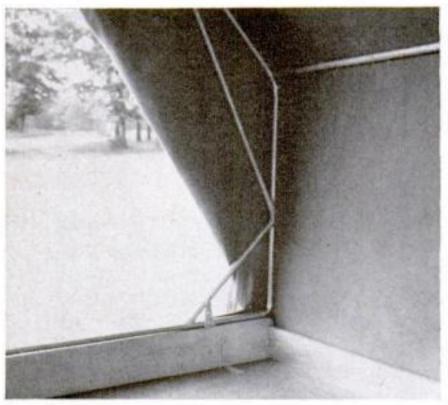
Home from work on a fine Friday summer evening, a weekend of fishing and water skiing looms big. Your

favorite lake is too far away to reach that night, but that doesn't mean you have to cheat yourself of precious hours by waiting for a crack-of-dawn start.

"Let's go," you say to your wife. She, having detected that come-out-



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OPEN FRONT END OF RAISED TENT shows hinged-steel end frame. Ridge and eaves poles are the only detachable parts of the rig.

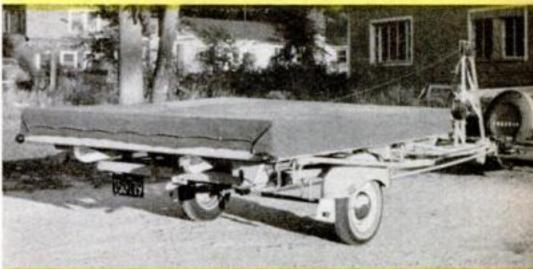
2 for overnight stops enroute, raise tent in 60 seconds—and bed's ready.



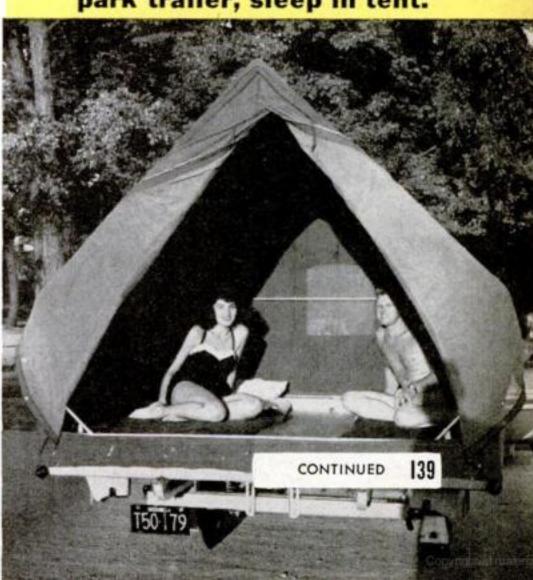
3 when you reach your destination, lift the platform, and launch your boat.



4 during your stay on shore, tent and platform are lowered like this for . . .



5 ... the answer to the crowded motel situation—park trailer, sleep in tent.

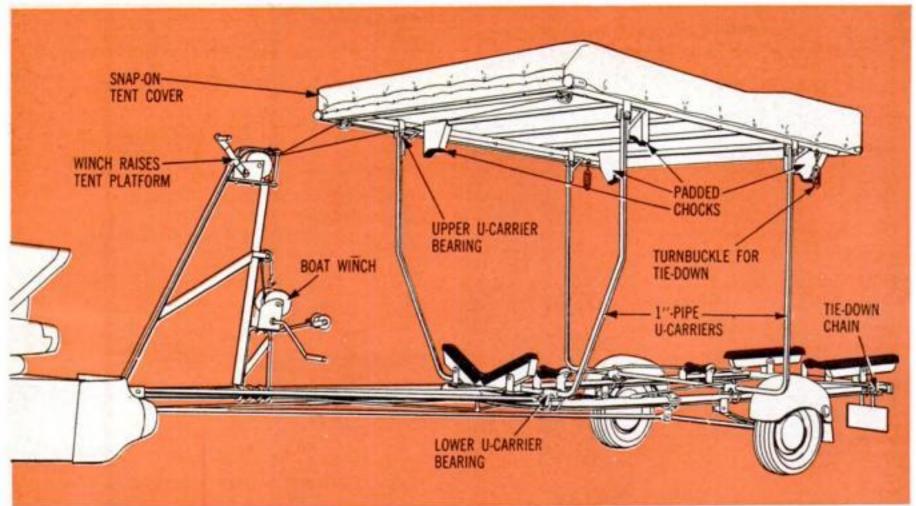


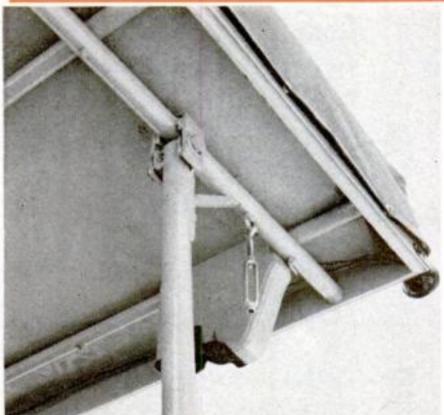
doors glint in your eye, already has packed a picnic basket and is stocking up the portable refrigerator. You hook the boat trailer to the family bus, toss in swim suits and the gear for an aquatic spree.

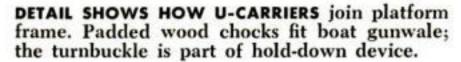
As you drive and the daylight hours dwindle, or you feel tired, you pull into the first turnout along the road. Walking back to the trailer, you unsnap the canvas cover on the flat package on top of the boat. Swing up two end frames and a tent is raised; hook in a ridge pole and two eaves poles. Bedding is made up on the ½"-plywood floor. Your sack is ready in minutes.

At sunup, between yawns, you fold down the tent, snap on the cover, and get under way in a hurry. Munching a breakfast sandwich as you drive, you've already stretched out your weekend. No time-consuming making and breaking of camp; no hunting for motels with a vacancy.

Arriving at the lake, you back down the beach to the water and winch up the tent platform on its two U-shaped car-



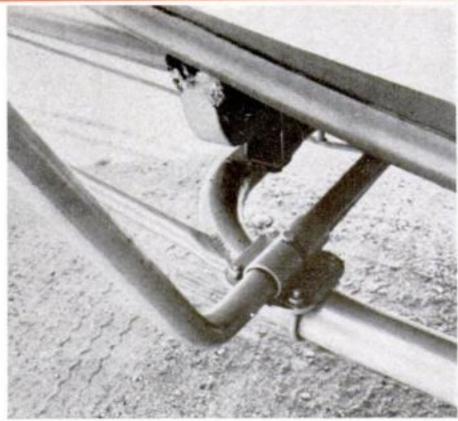




riers to give the boat clearance. Then, after the outboard has been launched in the normal way, with its own winch, you pick a choice parking spot, lower the platform to the trailer cradle, and put up the tent as you did the night before.

By the time the latecomers get there, you have camp all snugged up and are out on the lake fishing.

This can be you: because the two young men from Agawam, Mass., who thought up the "boatent," and hope to produce it commercially, have ironed out the bugs. Bill Gile, a high-school shop teacher, and Maurice Nelson, a civil engineer, each built an individual rig to fit



U-CARRIER BEARINGS ARE FASTENED to trailer frame by U-bolts. Carriers are 1" pipe, bent to shape. Cap screws keep them in position.

his own boat, and put them through three summers of road and camp testing.

One of their problems was shrinkage of their standard seven-foot-square wall tents. The canvas ripped when it became too taut over the rigid steel framework. Now they have spring-loaded, telescoping eaves and ridge poles that have four inches of play. As the tent shrinks, the poles shorten.

Another road-tested device holds the tent package securely down against the deck of the boat while traveling over the roughest of roads. Two turnbuckles, one on each side, are attached by short chains to the trailer.



▶▶▶I FOUND an easy way to stop a toilet flush-tank inlet valve from leaking. I removed the valve assembly and applied several coats of rubber cement to the valve face. Then I replaced the assembly while the cement was still tacky. The rubber filled pits in the valve seat and formed a durable leakproof surface on the washer.—Carl L. Beddig, Oakland, Cal.

Anchoring Paint on Ladder



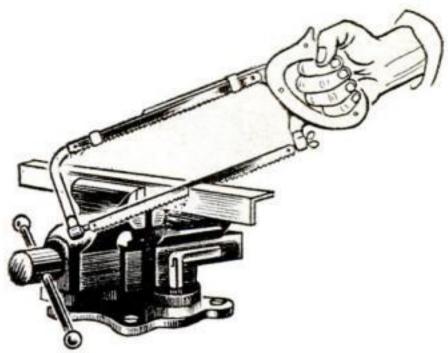
A PAINT can will be safe on the top of a step ladder if you hold it with a C clamp. Stretch a heavy rubber band over the can and run the screw through.— Daniel Bousha, Jackson, Mich.

Short Cuts and Tips

FROM PS READERS

Towel Rack in a Cabinet

If you don't like towels hanging in the kitchen, you can build a rack that will slide in and out of a cabinet. Make a rectangle of 1"-by-1" stock and bore paired blind holes in the ends to take three or four stainless-steel rods. Assemble with glue and mount on cleats in a base cupboard. Holes in the upright piece behind the toe space provide ventilation—J. L. Wilson Jr., Binghamton, N.Y.



Storing Spare Hacksaw Blades

A CONVENIENT way to keep spare hacksaw blades is to tape them to the top bar of the saw frame. You can then be sure of having an extra handy if one should break while you are at work on an outside job. —N. S. Steigman, Howard Beach, N.Y.

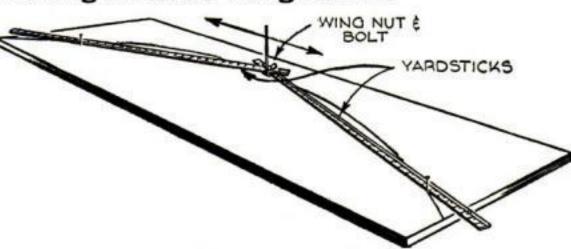
How to Lay Out a Curve Having an Extra-Long Radius

IN BOATBUILDING and cabinetmaking you are often called upon to lay out large-radius arcs.

You can do it easily with two yardsticks or battens held together at the ends with a small bolt and wing nut.

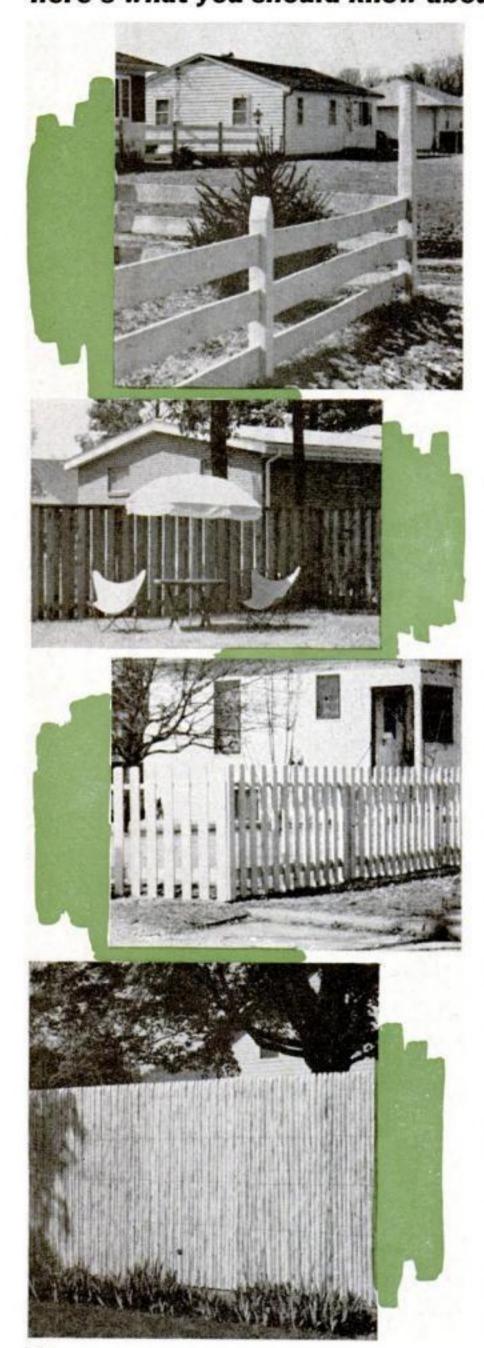
Drive in nails at two

points and clamp the straightedges at a suitable distance from the chord. Then, with a pencil held firmly in the angle of intersection, draw the arc by sliding the



straightedges on the nails. By varying the angle between the two sticks, you can makes arcs of shorter or longer radius.— James D. Chapman, Memphis, Tenn.

To be a good neighbor, and remain one, here's what you should know about



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Keeping Line Fences Within the Law

By William B. Eagan

Down in Louisville, Ky., immediately after a man built a stockade fence 10 feet high around his lot, the zoning board ordered him to remove it. His neighbors had protested, and the law was on their side. Local zoning there restricts fences to a four-foot height.

Fences are a prime source of neighborhood feuds. Every day courts are passing judgments on such controversies. At issue may be a state law, a local ordinance, a zoning decree or perhaps a special restriction in the deed and covenants applying to a particular piece of property.

Strange legal quirks. Search out all restrictions. For instance, did you know that:

• In most communities, you can be found guilty of trespass if you build a fence exactly on your property line?

 You can be held liable for damages if someone should hurt himself on your fence?

You can be forced to share the expense of mending a fence belonging to a neighbor whose land adjoins yours?

You can run afoul of the law by erecting a fence that impedes natural water drainage or that merely restricts the view of your neighbors?

Ignorance of the law is no defense. This holds true in fence cases as in other legal hassles. Take the case of poor Harry M. who moved into a brand-new home in Cincinnati. To safeguard his children, he decided to fence the back yard.

Finding that his property line split the middle of a shallow drain ditch between his yard and his neighbor's, he set his posts in the center of the ditch. When the fencing was complete, he filled in the half of the ditch on his side, level with the rest of his yard.

During the first heavy rain, the ditch overflowed on his neighbor's yard and

flooded his garage.

Harry M. refused to pay damages since he regarded one half of the ditch as his own to do with as he liked. The court saw it differently. Harry had to pay for the damage. He was also warned to relocate the fence and to restore the filled ditch to its previous shape and size.

What law had Harry broken? A very old and simple one, yet surprisingly not too well known. You can't alter the natural contours of the land in any way that affects a neighbor's property. This is so even if you do the job on your own land.

The question of repairs. John T. in another state was even unluckier. He bought several acres of country property as an investment. It was fenced in, but the fence needed repairs. Soon the owner of the adjoining land submitted an estimate for repairs to John and asked him to pay half. John refused.

The county trustee warned John to pay, but he refused. What happened? The county had the repairs made, then added the cost to John's tax bill.

John couldn't win. A state law required that all fences be set on boundary lines, automatically making them the joint responsibility of owners on each side.

In other areas, you may find that on
NO MAN'S LAND between parallel fences starts fights, looks silly, wastes land and may be

illegal. But, in some cases, a setback fence may be the only answer to a grouchy neighbor. the-line fences aren't permitted because of the legal battles that often result. Many communities now forbid shared driveways for the same reason.

No barbed wire. Often an illegal fence will go unnoticed until something happens. An Indiana homeowner hurriedly erected a temporary barbed-wire enclosure to keep out roving dogs until a more expensive fence could be built.

Everything was fine until a child chasing a ball fell into the barbed wire and was badly cut. The child's parents sued, the town suddenly lowered the boom, and the homeowner had to pay a steep price for his "cheap" fence.

Barbed wire, similar sharp-pointed designs and electrically charged fences are almost universally outlawed nowadays. One exception: A fence *topped* with barbed wire is frequently legal for guarding such hazards as swimming pools.

Know your boundary lines. Another homeowner very carefully set his fence on what he thought was the inside edge of his property line. A resurvey made by a new owner next door showed the line to be 2" off, and the new neighbor got a fine fence free. A more ornery newcomer could even have had the fence removed—and kept the materials himself.

If you can't locate surveyors' markers, better have a new survey made.

Consult your neighbors. Because fences

Three ways in which the unwary



JOE LOST A BRAND-NEW FENCE when he found he couldn't paint it without trespassing on his neighbor's land. He should either have obtained an easement or built it farther back.

are automatically interpreted as "Keep Out" signs, neighbors can be offended easily. Law or no law, it's a good idea to get your neighbor's consent to a fence. And it's a still better idea to get all agreements in writing.

George and Charley were great nextdoor pals, so when they decided that a fence would look nice between their houses, they had no problem in agreeing to share the cost and upkeep.

Then George's office was transferred to another city and he had to move. Charley's new neighbor not only balked at

Quick Answers to Trick

If my neighbor erects a fence on my property and I do nothing about it, would the land on his side of the fence become his?

Yes. If you permit an encroachment for a length of time specified under local law, he can take title by a process called "adverse possession."

If my neighbor gives me verbal permission to build a fence half on his side of the boundary, can he make me remove it if he changes his mind later?

Not if you can prove he said it and the court rules that an "irrevocable license" has been created. But verbal agreements are hard to prove. To be

safe, better get it in writing and have it recorded in both of your deeds.

If I find that a fence encroaches on my property, can I remove it myself?

Yes, provided the location of the fence has not already been established by an easement or some other agreement. It's best, in any case, to consult your neighbor first and try to get him to remove it.

If my neighbor and I have shared an on-the-line fence by formal agreement, and he now wants to remove the fence, can he do so without my consent?

No. But you may have to buy his half of the fence to prevent its removal.

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fence builder can get into trouble with the law



BOB WAS SUED FOR DAMAGES because his fence, blocking the view at an intersection, caused a collision. Usual rule: Half a fence's total area must be open for good visibility.

paying his share of the maintenance—he wouldn't even let Charley come over on his property to paint it.

Even if the fence is on your side of the boundary line, remember that it's impossible to work on the other side of it without trespassing on your neighbor's property. Agreements to share costs, and easements to allow you in the other fellow's yard, should be recorded right in the deed to each owner's property. Even written agreements expire as soon as either party moves away unless they are made a permanent part of both deeds.



JIM'S HEDGE WAS A FENCE in the eyes of the law. He had to tear it out when he learned, too late, that he had planted it on public property—right where a new sidewalk was to go.

When Bill moved into a small eastern town, he found his property already partially bounded by a neighboring fence. Instead of building a whole new fence, he received permission to extend the existing fence, offering in return to pay half its original cost.

Bill thought this gave him title to half of the fence. It didn't. When his neighbor moved away, the new tenant politely suggested that Bill could either "buy" the fence over again or take down the part that entered the neighbor's yard. Bill

[Continued on page 206]

Questions About Fences

I made the mistake of erecting my fence on my neighbor's property. What can I do?

You can try buying a strip of land from him or ask for an easement. Otherwise, he can have the fence removed.

My neighbor has erected a 10-foothigh tence. Can I make him lower it?

A Yes, if it is higher than local restrictions allow or blocks your natural view. Consult your zoning board.

My neighbor and I have parallel fences and he refuses to keep his part of the center strip clean and mowed. Can I force him to do so?

This depends on local building and health codes. Proper maintenance is required by some, not by others.

Recently a car damaged my fence. Can I make the owner pay for repairs?

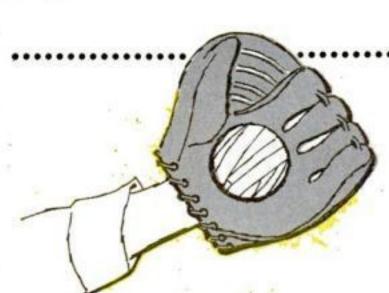
Yes, if your fence isn't on the road right-of-way and thereby a hazard. You'll have to sue him, though. Local laws set rules, but do not settle claims.

I built a 10-foot-high privacy barrier in my back yard. Would this be considered a fence?

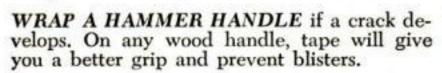
Not unless it is on or near a property line. However, it may be subject to other building restrictions.

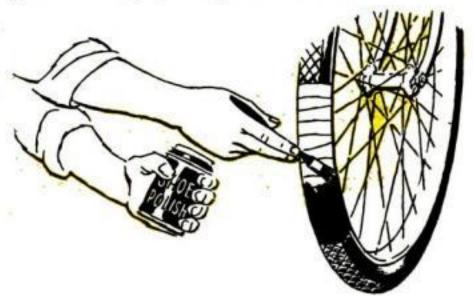


7 Extra Uses for Adhesive Tape



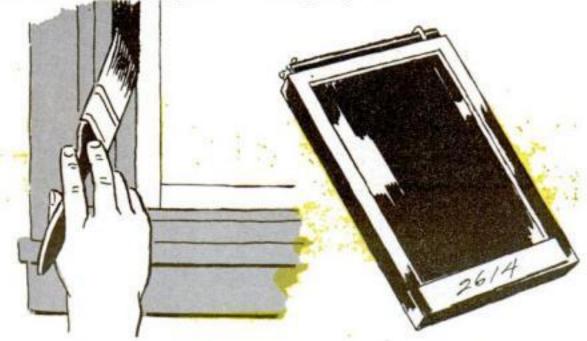
COVER OF JUNIOR'S BASEBALL about to come off? Wrap it tightly with adhesive tape and the ball will be almost as good as new.

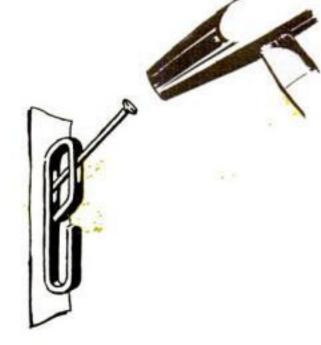




A BICYCLE TIRE that has worn through to the fabric can be saved. Wrap tape tightly around the tire, apply black shoe polish, and you have a "recap" good for emergency use.

APPLY IT TO OUTLETS near the floor if you fear a youngster may stick in metal objects. Paint it to match the faceplate color.



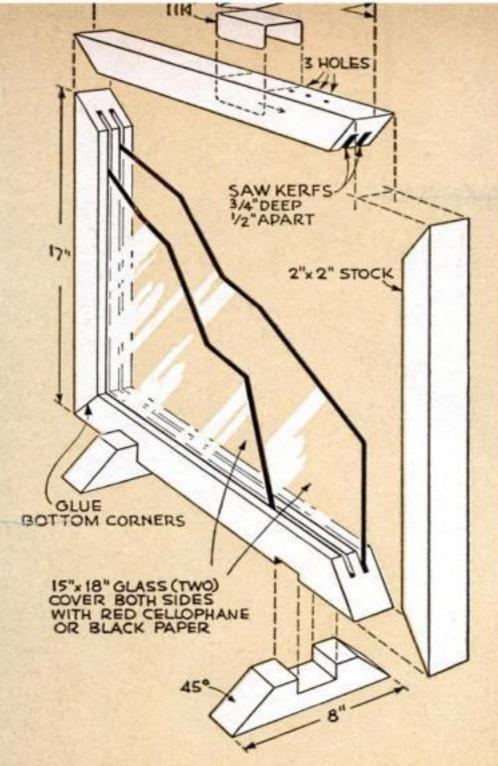


FOR SMALL PAINT JOBS, such as window sash, a strip of adhesive tape works fine as a masking-tape substitute. For fine stripes, place two strips close together and paint between them.

A FILM HOLDER can be marked by applying a thin strip of adhesive tape, then writing the negative number on it. Use similar tabs on 35-mm, negative cartridges.

BEFORE DRIVING A NAIL into a plaster wall, cut off a short length of tape and press it against the spot. This way the plaster beneath it won't crack or chip out.

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MATERIALS YOU NEED for this ant house are an 8'-long two-by-two and a pair of 15" by 18" panes of glass. Glue and nail bottom corners; leave top frame member free for access.

A FILE FOLDER acts as an effective funnel for emptying a collecting bag of ants into the house. House is then kept in dark several days to let ants get accustomed to the new home.

IVE o'clock, and the city's office workers descend from the sky-scrapers, vanishing into the subways below the metropolis.

A few miles away, also underground, similar events are mirroring the city in miniature. A colony of ants is preparing for the night.

Next to man, ants and bees have developed the most complex society on earth. And some scholars place man second.

Keeping ants for study has become increasingly common, largely because of the ant houses or "palaces" now being sold in dime and department stores.

You can use many types of containers. The main thing is that they permit the ants to be seen, yet keep them in their place. A screw-top jar with holes punched in the lid will work. Or better, a picture

frame, nailed flat to a board with glass resting on top makes observation easy and provides access.

Another type can be made by placing one glass baking dish inside a larger one and pouring water into the space between. The dish should be divided into four or five rooms with walls (and little doorways) made of a material such as molding clay. One or two of the chambers should be kept dark. Dirt isn't necessary. However, the absence of earth, though making for easy observation, does not allow the viewer to watch an interesting activity—tunnel excavation.

The most satisfactory ant house in my experience, however, has been a large double-glassed affair easily built with woodworking tools. First, make two lengthwise cuts 3/4" deep and about 1/2"

[Continued on page 208]

FOR THE HANDYMAN Outdoors

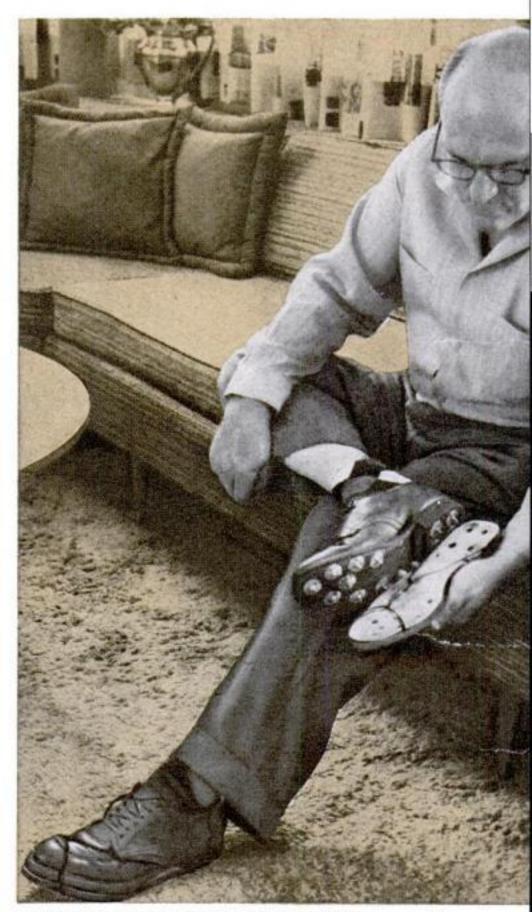


RAIN WATER FILLS THIS POOL. Filling our pool would be too much drain on our well. So each spring we fill it with rain water from the roof, then start the filter system operating.—John Mihalick, East Liverpool, Ohio.



and rag bin, with a useful shelf to boot. Here's mine, conveniently located on the garage wall.—Thomas P. Morgan, Washington, D. C.





SPIKED SHOES IN THE LIVING ROOM? Sure—with these sneaker pads. Make them from a pair of women's thick-soled beach clogs. Press the spiked shoes down on white cardboard and shape the cardboard to the shoes to get patterns for adapting the beach clogs. Put a pattern on each beach clog and drill holes for the spikes. Also drill holes for insertion of shoe laces from side to side to hold on the pads.

REFRESHMENT TRAYS attached to outdoor furniture like this are very convenient. Cut the plywood disks to suit the plates or trays that you select. Glue the dowel to the underside of the disk in an offset position—about 3" from the edge.—W. G. Waggoner, Sacramento, Cal.

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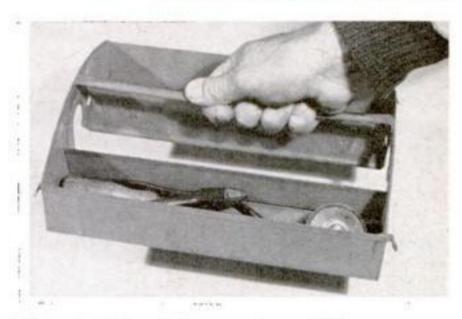


Door-Top Safe Hides Jewelry

When my wife asked me to price a wall safe for her valuable jewelry, the cost drove me to ingenuity. Instead of paying out cash, I chiseled a 1"-by-4" recess 2" deep in the top of a closet door—room for a necklace, rings and small pieces. With the door closed and locked, they are safe.—John A. Comstock, Wellsboro, Pa.

▶▶▶PLIERS cost money. You can save the ones you have by periodically servicing them with a slim taper file. Work the file through each valley between teeth to restore gripping power. Clean with a wire brush.—M. Robert Beasley, Jackson, Mich.

Short Cuts and Tips FROM PS READERS



Handy Tool-Carrying Kit

The dirt-collecting troughs from a discarded carpet sweeper make a convenient toolbox for taking to a job outside the shop. All you need do is disassemble the sweeper, remove the troughs and clean out the dirt. They are joined in a single piece. The rod at the top will serve as a handle.—Hi Sibley, Nuevo, Cal.

▶▶▶IF A medicine-cabinet door backs up against its shelves, the silvering is likely to wear off in streaks. I solved the problem by applying adhesive tape to the mirror along the contact points.—

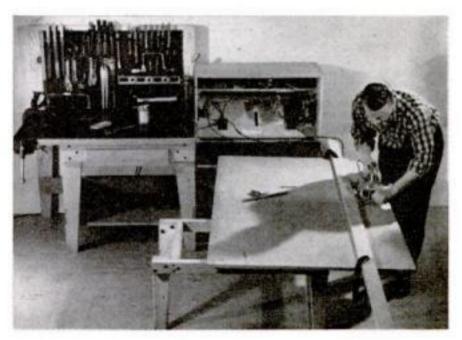
Leonard J. Dobucki, Frederick, Md.

Coming in September . . .

The Popular Science Split-Level Workbench

A STAND-UP work surface and a lower level to sit at when tinkering . . . Plugged-in power-tool storage—the tools always ready for instant use, yet always under lock and key . . . A pull-out utility table for use as sawhorse, gluing table or general assembly . . .

You'll find all this and more in the upto-date work bench designed by the editors of Popular Science Monthly especially for modern power tools. A large, detailed blueprint folded into the September issue will show you how to build it.



Pushbutton Controls for Garage Doors

By George Daniels

A MECHANICAL muscle to open your garage door used to be considered a wonderful bit of super-gadgetry.

Today, mass-market builders are installing pushbutton door openers in development houses as standard equipment. Like the "free" dishwasher or food freezer included with every house, their appeal to buyers is worth many times more than their cost.

Two popular misconceptions that may have helped to keep this from happening sooner are that automatic controls are hopelessly complex electronic devices, costly at best and temperamental at worst. Neither is true.

While radio controls are among the fanciest and most expensive, they are by no means the only type you can buy. Much cheaper—yet less well known—is

the simple switch type, mounted carwindow high on a post at the entrance to your driveway. As you turn in, you just reach out and push a button.

Better and cheaper. Today, you can have a completely automatic garage door for the price of an ordinary household appliance like a refrigerator. For as little as \$100, you can add an automatic control to any existing door.

Some earlier models with the habit of responding to dog whistles, car horns and squealing brakes have either been taken off the market or made foolproof.

Should you buy one? The sheer luxury of driving home on a cold, stormy night and watching your door swing magically open before you may be justification enough for parting with the purchase price. If it isn't, doormakers offer further inducements.

You'll be spared 3,000 trips in and out of your car and 29,000 steps a year,

Four ways you can command your garage door to open magically



RADIO CONTROL, actuated by a button on your dash, enables you to open your door without stopping or slowing down. One of fanciest, it is almost foolproof against accidental opening by other cars, is also one of costliest.

KEY SWITCH at entrance to driveway is the cheapest control you can have, but you must stop your car to operate it. Because many openers use low-voltage wiring, the hookup of switches is safe and easy to do yourself.

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NEW REMOTE CONTROL is this tiny battery transmitter that flips open a garage door from any car or anywhere around your house or yard. It's available from suppliers of door operators such as Alliance Mfg. Co., Alliance, Ohio, and Edward T. Fink Co., Yonkers, N.Y.



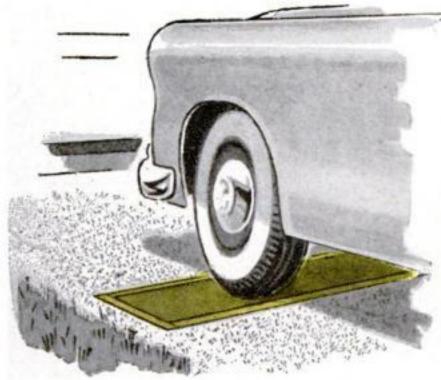
figures one company. You'll stay healthier because a self-powered door keeps you out of the rain and snow. Your fuel bills will be lower because an automatic door is open only a few seconds a day, while human laziness may leave a manual door open all day long, wasting heat.

Some of this is nonsense, but the fact is, automatic doors do make sense. Many new models will turn on a light for you as well as open the door. If you have a steep driveway that ices up badly in winter, a remote-control opener may be the only way you can get a running start and reach your garage without stopping.

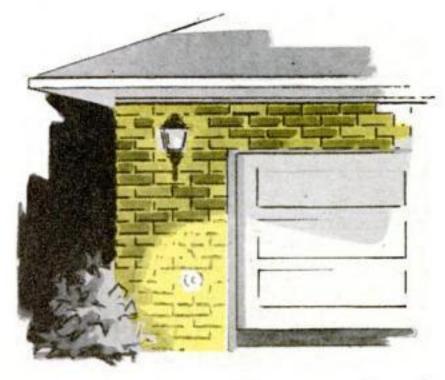
You can have any control you want. The muscle that moves the door is the same no matter what system you select to control it. This is an electric motor of 1/6 to 1/3 hp., geared down to drive a chain or cable that pulls the door.

Since any of several systems can be

at the touch of a switch without even getting out of your car



pressure-operated treadle buried in your driveway is next cheapest to a key switch and makes it unnecessary to stop your car. But it can be operated by any cars—including daily delivery trucks—that enter your driveway.



front of the garage and tripped by flicking your headlights in a pre-set code. It's less expensive than a radio control, but can't be triggered any farther away than your beams.

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Plug-together parts let you combine any "brain"

used to trigger the motor, this means that you can start out with a switch, then add a radio control later. You can also combine controls. You can have a dashmounted transmitter, for instance, plus a switch inside your house and maybe another in the yard so you can open your garage even when your wife has the car downtown shopping.

Most standard openers are designed for upward-acting doors, either the sectional or one-piece tilt-up type. Special hookups can be rigged to operate swinging doors, but as these are costly, it's usually best to install a new door. Single tilt-up doors start as low as \$56.

Prices for door operators alone—motor, hardware and a switch control—start around \$100, average about \$140. Most newer units include a safety switch that automatically stops or reverses the door if it strikes anything while closing. Be sure the one you select has this precaution to safeguard children or pets that might be in the way.

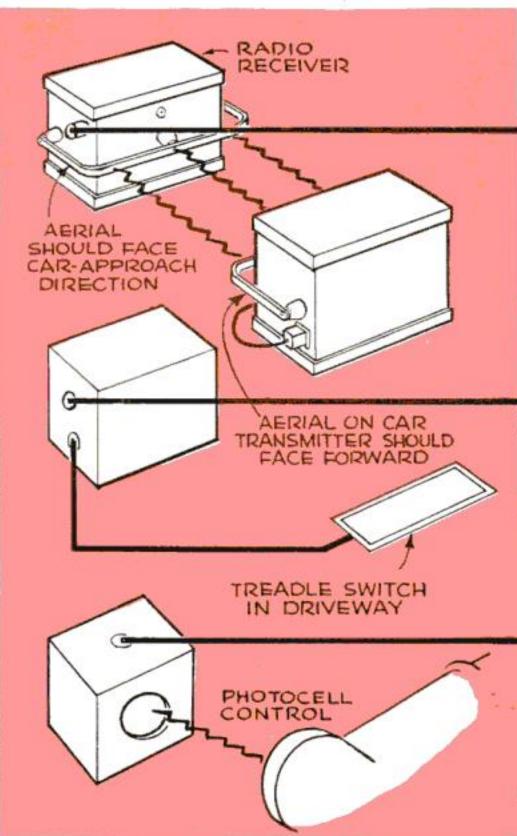
In-the-car controls. Most popular type, despite its higher price tag, is the radio control. This consists of a receiver in the garage and a transmitter operated by a pushbutton on the dash.

Radio controls—including receiver and transmitter but not the actual door operator—range from \$80 to \$100, with a few as low as \$50. Where more than one car will operate the door, additional transmitters are needed at an extra charge of about \$25 a car.

New this year is a small pocket-size transistor transmitter that runs on hearing-aid batteries. Not wired to your car, it lets you open your garage door from any room in the house, anywhere in your yard or from any car that you may be driving—merely by reaching in your pocket and pushing a button. These cost about \$37, not including the receiver.

Keeping out strays. Two major improvements have been made in radio controls to prevent their being accidentally triggered by unwanted signals.

Instead of operating on a single broad band, most new units give you a choice of up to 200 different signal settings so that you and nearby neighbors can each zero in on your own garage without affecting others. At the same time, re-



BASIC "MUSCLE" is an electric motor, as in the typical setup shown at right. Into it can be plugged any of several "brains"—pushbutton controls—such as the radio, treadle switch or photocell above. When a brain tells the muscle

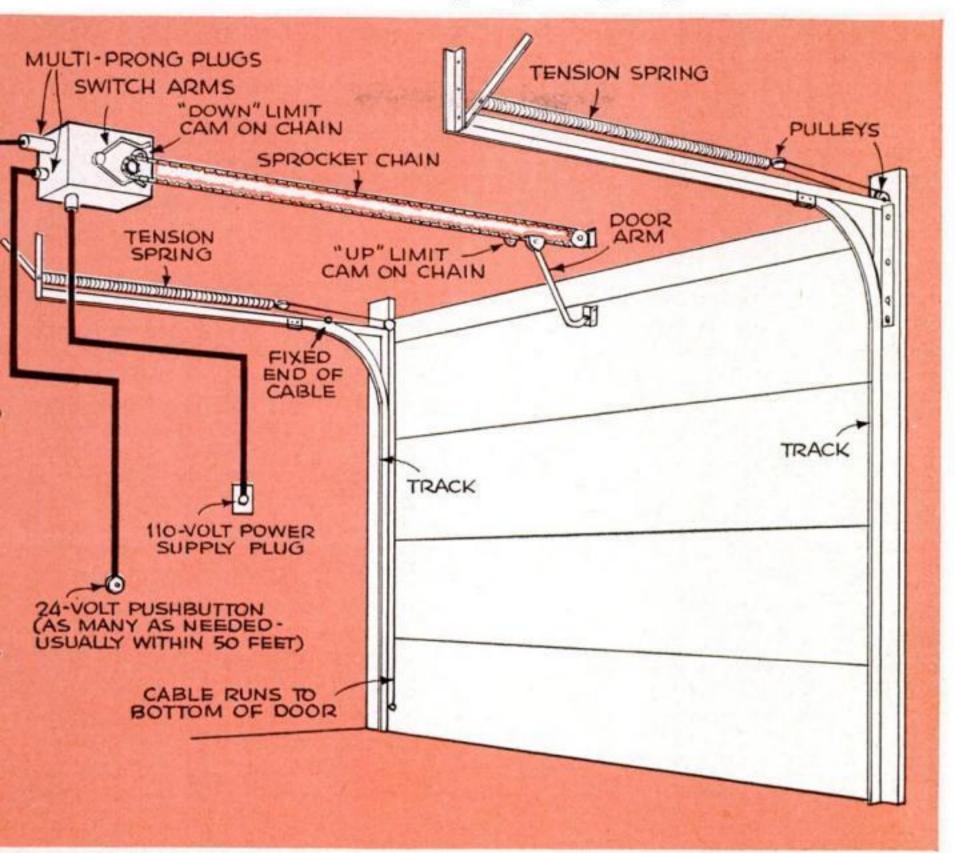
ceivers have been made less sensitive so they won't pick up stray signals.

The big advantage of a radio control is that it also keeps out intruders, not possible with most other control systems. Only you in your own car can open your own garage.

In case of a power failure, you can open the door manually, but you'll first have to go around and pull a cord or lever from inside the garage to disengage the automatic control. The drawback is that if your garage has no other entrance you'll have to mount the device on the outside, within reach of prowlers.

Timing your run. The range of a

with one basic "muscle" to open your garage door



to move, the motor starts driving a chain (or similar linkage) that pulls up the door until an "up-limit" stop fastened to the chain strikes a switch arm on the motor. This automatically stops the motor and sets it for reverse rotation

the next push will open the door and the cycle will be repeated as often as necessary. buy has at least the minimum required

so that the next push of the control button will

close the door. The "down-limit" stop then

shuts off the motor and reverses it again so that

radio control must be great enough to permit your door to be open by the time you reach it, yet not so great that it responds to distant signals. For this reason, the rule is to adjust the receiver so that its range just matches the distance required to give the door time to open.

Most doors open within five to seven seconds, but it's best to allow 10 for a safe margin. If you approach at 15 m.p.h. (22 feet per second), your control must start to operate at a distance of 220 feet.

The faster you drive, the greater the control range you need for a nonstop approach. Make sure that the unit you

buy has at least the minimum required range.

Cheapest control you can buy is a weatherproof switch mounted on a post at the entrance to your driveway, with an underground cable running to your garage. To make it burglarproof, you can buy a key-operated switch for about \$12.

A second switch inside the garage shuts the door after you and also opens it on the way out. The main thing you lack in a switch arrangement is the luxury of a completely nonstop landing.

Photocell control. This system has recently been improved to respond only

to a brief pre-set dot-dash code from the car's headlights, even in dazzling sunlight. But as code combinations are presently limited to about five, this type is sold on the basis of low cost rather than bank-vault security. Professionally installed, a typical photocell control, complete with electric operator, sells for about \$150.

Radar control. Highest priced of all systems, this type beams its signal from the garage to the car, where, at the press of a button, it is modified by a dimesized crystal and bounced back to a receiver also in the garage. Unlike most radio types, it uses an outside hairpin antenna, but it's practically as pickproof as a tumbler lock. Price for radar control and door operator, installed, is about \$300.

Off-beat controls. Two types of pressure switches are sometimes used. One is a treadle plate buried in the driveway (like the switches used on automatic traffic lights) that opens the door when the car is driven over it. As it is triggered by pressure alone, any car can operate it.

The other is the familiar hose often used to ring a bell in a service station when a car drives in. It's simple and inexpensive to install but it isn't selective, and children enjoy jumping on it.

Horn-triggered openers, one of the earliest systems tried, had the unfortunate habit of responding to blasts from passing cars and have been largely abandoned.

Operating costs. Allowing radio receivers to run continuously may sound expensive, but actually they burn only about 12 watts, little more than the smallest night light. At average electric rates, this is about a dime a month if you never turn the control off, a nickel if you turn it off at night. The operator motors, running only one to three minutes a day, may bring the total cost to about 50 cents monthly.

Pro vs. do-it-yourself. You pay more to have your door and its operating equipment professionally installed, but you get a parts guarantee that may not apply if you do your own work. Some makers produce special kits designed for amateur work, complete with detailed instructions. Others flatly discourage amateur installation and may not be too helpful if you get stuck and are in need of advice.

Here's how the figures compare on a typical one-car sectional door:

P	rofessionally installed	Homeowner installed
Door	\$ 85.00	\$ 65.00
Operator	150.00	120.00
Radio Control	75.00	50.00
	\$310.00	\$235.00

Check your garage's vital statistics before you buy an opener

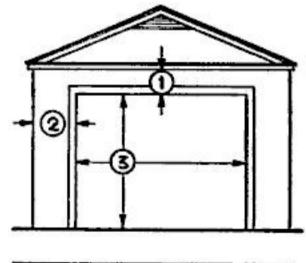
THE mechanisms that do the actual job of opening a door come in many types and sizes, some of which may not fit your particular garage. Check these four measurements before you choose an opener:

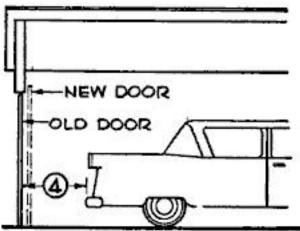
1. Headroom. Doors and operators may require as little as 2" from the top of the door opening to the ceiling or as much as several feet.

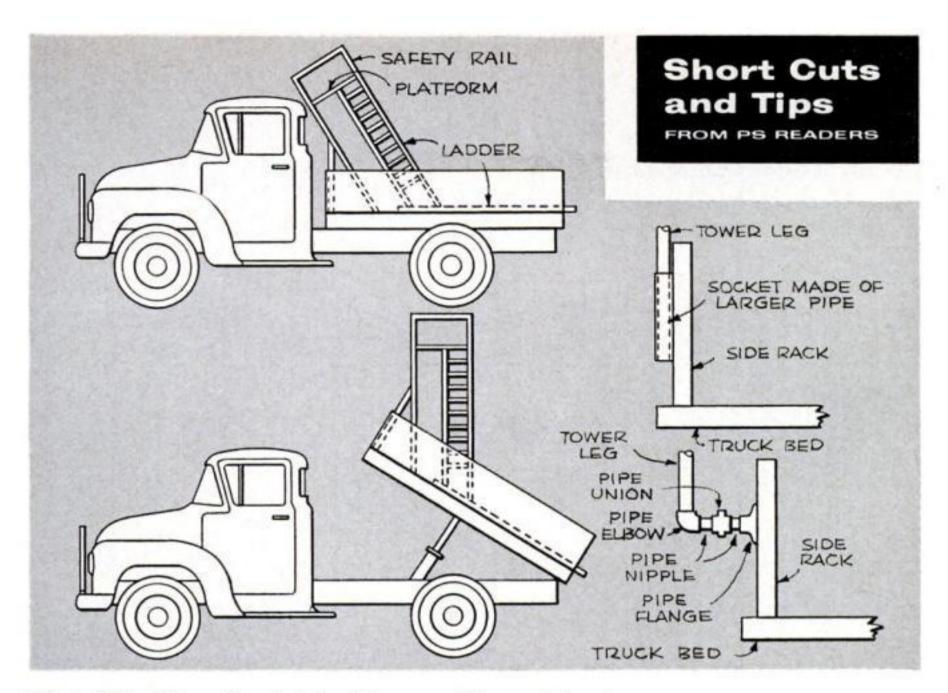
 Sideroom from door opening to wall (or across the centerpost in a two-door garage). You may need 5" or 6" here (double this at a centerpost).

3. Size of door opening. If you're short on headroom or sideroom, you may be able to reframe the door opening to gain more space. But be sure you'll have enough opening left for an adequate door.

4. Amount of clearance from the rear of your car to the present door. This is important to know if you're planning to add a new door as well as an opener. Upward-acting doors usually mount inside the position of old-style swinging doors, meaning you'll need 6" to 8" extra room to allow for this.







High-Working Aerial Ladder on Dump Truck

We needed a rig to help with overhead maintenance work at Algonac State Park, so we put an aerial platform on a dumptruck body. We built it of two-by-fours, making the forward legs shorter than the back so it would stand upright when the

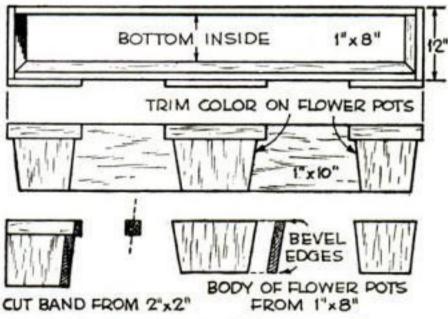
dump body was raised, braced it diagonally and bolted a ladder to the floor of the truck in order to reach it. It could have been made as easily from $1\frac{1}{4}$ " pipe and removed when the dump body was in use.—Carlton T. Althoff, Algonac, Mich.



Drill-Press Pipe Jig

A SIMPLE jig that will hold round stock in place for drilling can be made from two 8" lengths of \(^1/8\)"-by-1"-by-1" angle iron. You should be careful in welding them together so that they form a perfect X. Then any of the four V's can be used for holding the stock while drilling.—

Arthur R. Tanner Jr., Poughkeepsie, N.Y.



Pot Cutouts on Window Box

You can make window boxes from scrap stock and decorate them with cutouts that look like flowerpots. The bottom is slightly smaller than the top opening so the front and ends slant inward. Saw a two-by-two at the same slant for flowerpot rims. Paint in contrasting colors. —Arthur N. Nelson, Kansas City, Mo.

Short Cuts and Tips

Sturdy Knockabout Stool

This stool was built eight years ago in the hope that it would survive the treatment numerous children had handed out to commercial articles with disastrous re-

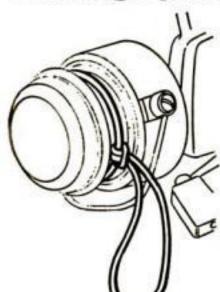


sults. It's still in active use, has had no repairs or maintenance other than an occasional painting. Its strength lies in the center spacer, nailed and glued to both legs, and in the

top. They keep the legs from racking. Another advantage is that the grain of the seat runs crosswise between the side rails, providing very rigid construction.

—Edward E. Thorp, Montclair, N. J.

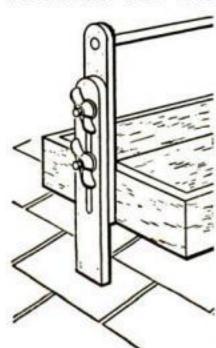
Securing Spinner Line on Spool



Two rubber bands looped together will keep a spinner line from unwinding on the spool when it is not being used.

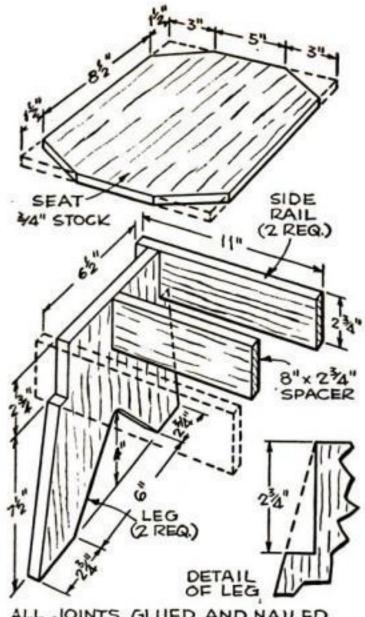
Loop one of the bands over the spool; the other will act as a tab that can be grasped for removing quickly.—R. R. Rundell, Miami, Fla.

Toolbox for Use on a Roof



By adding an adjustable leg at one end of a toolbox you provide level support for it on any pitched roof. Slot the leg to fit over a pair of projecting bolts on one end upright. It is held by butterfly nuts when raised or lowered into position.—G.E.Hendrickson, Argyle, Wis.

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ALL JOINTS GLUED AND NAILED WITH 2 NAILS: 1" APART

From Shoulder to Camera Bag

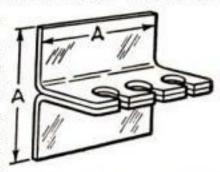
When the lady of the house discarded her leather shoulder bag, my son quickly retrieved it.

He has been using it since as a gadget bag for carrying his box camera. It has room for film and a flash attachment.—
R. M. Woodbury,
Natick, Mass.



Built-in Tile Toothbrush Holder

If you are refinishing your bathroom walls with plastic tile, you can build in a toothbrush holder with two pieces of the same tile. Have



the dealer bend two of the tiles at right angles so that when you cement them together the flat sides will form a perfect square. When the bond dries, notch the projecting edge with a coping saw to hold as many toothbrushes as required.—Alice B. Peirson, Kennett Square, Pa.



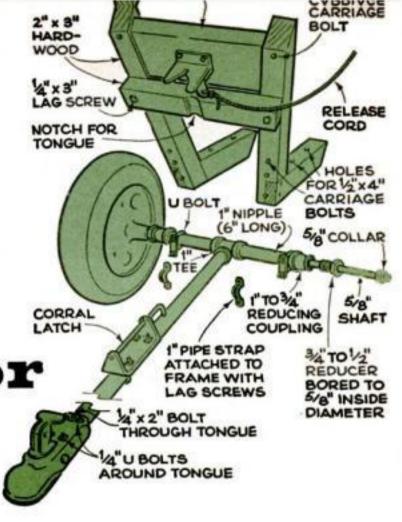
HOW I BUILT A SACTOR Garden-Tractor Dump Barrow

ONE of my most useful garden-tractor accessories is a dump trailer that I built for less than \$65, using simple hand tools.

The hopper is a four-cubic-foot aluminum wheelbarrow bowl—a replacement stocked by many hardware stores. I attached this to a hardwood frame with eight carriage bolts. For the T-shaped trailer chassis I used galvanized pipe and fittings. The axle is a length of 5/8" shafting, slipped through the cross member. A pair of shaft collars fitted with setscrews hold the wheels in place.

A pull on a leather thong opens a corral latch, freeing the forward end of the underframe from the tongue. This makes dumping the barrow easy.—R. B. Lewis, Menlo Park, Cal.

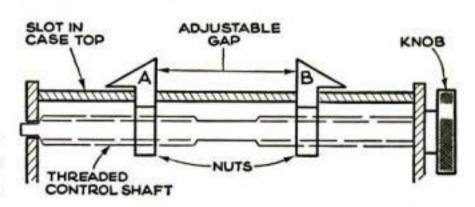
IN FULL DUMP POSITION, the rim of the wheelbarrow bowl rests on the ground. The quick-release trailer hitch is convenient, but a less-expensive clevis could be used.





The Case of the Coarse-Threaded Vernier

EXPERIMENTER Joe needed a oneknob control to vary the distance between two small anvils A and B over a short range. This would have been simple with a screw having right-hand and left-hand threads, like a turnbuckle. But Joe's lathe was not the screw-cutting type, and his threading dies were the common right-hand kind. He wanted delicate vernier control too, but the finest die on hand cut only 24 threads per inch.



Nevertheless, he used the tools available to make a control that changed the spacing by 1/48" per turn of the shaft. By marking the knob's rim, he could obtain adjustments almost as fine as one-thousandth of an inch. How did he do it? For the answer, turn to page 167.

A repairman tells about new techniques now used in tracking down

The Gremlins in Printed-Circuit TV

By Art Margolis

Although printed-circuit television sets are fairly new, the odds are better than 10 to one that if you have a new TV it has printed wiring boards. They are easier to design and produce, and their circuits are compact and free of wiring errors. That's one big reason why your new set cost so much less than that old small-screen monster you may have relegated to the bedroom.

Repairing them, however, involves new techniques and the use of special tools.

A Case of TV Surgery

ONE of my recent printed-circuit jobs ran parallel to a repair job a doctor had made on the owner of the set.

The poor guy, a preacher, had broken a hip. It was splinted together with one of those metal pins that pokes through the skin on either side of the fracture and holds the break in place with a metal member along the bone. Still in a wheel chair, he watched me in a big wall mirror as I worked on his set.

The TV was a new table model, loaded with printed-circuit boards. Its ailment—a smeared picture. My diagnosis—a loss of high frequencies in the video.

In a TV picture there are all ranges of frequencies from zero to mega (million) cycles. When a point in the frequencies goes from black to white, the change takes place in the megacycle range. And with a high-frequency loss, the picture smeared when trying to change that fast.

Special circuits with peaking coils are used to pass such high frequencies. The indication in this case was that the set had lost a peaking coil. First I checked all the peakers, mounted atop the video

printed-circuit board, with my ohmmeter. They all read between the proper three and 15 ohms.

I decided to trace the wiring to the coils, and took an extension cord with a 60-watt bulb on it out of my printed-circuit kit. I lit the bulb and placed it behind the translucent printed-circuit board. The wiring stood out like a skeleton.

The preacher chuckled. "When the doctor fluoroscoped my leg I watched in a mirror, too. My fracture looked very like that skeleton wiring. See," he said, holding up an X-ray picture.

"Guess it serves the same purpose," I said, examining the wiring. There was a light spot on the lead that went to one of the peaking coils. "There's our fracture," I said, pointing. Then I took a piece of hookup wire and attached it to two points with some 60/40 solder and my small iron so the wire jumped the break. I turned on the TV. The smear was gone.

"Much like the way they patched my hip," said the preacher.

"Except for one small difference."

"Oh, what's that?" he asked.

"It won't cost you as much," I said, handing him a modest bill.

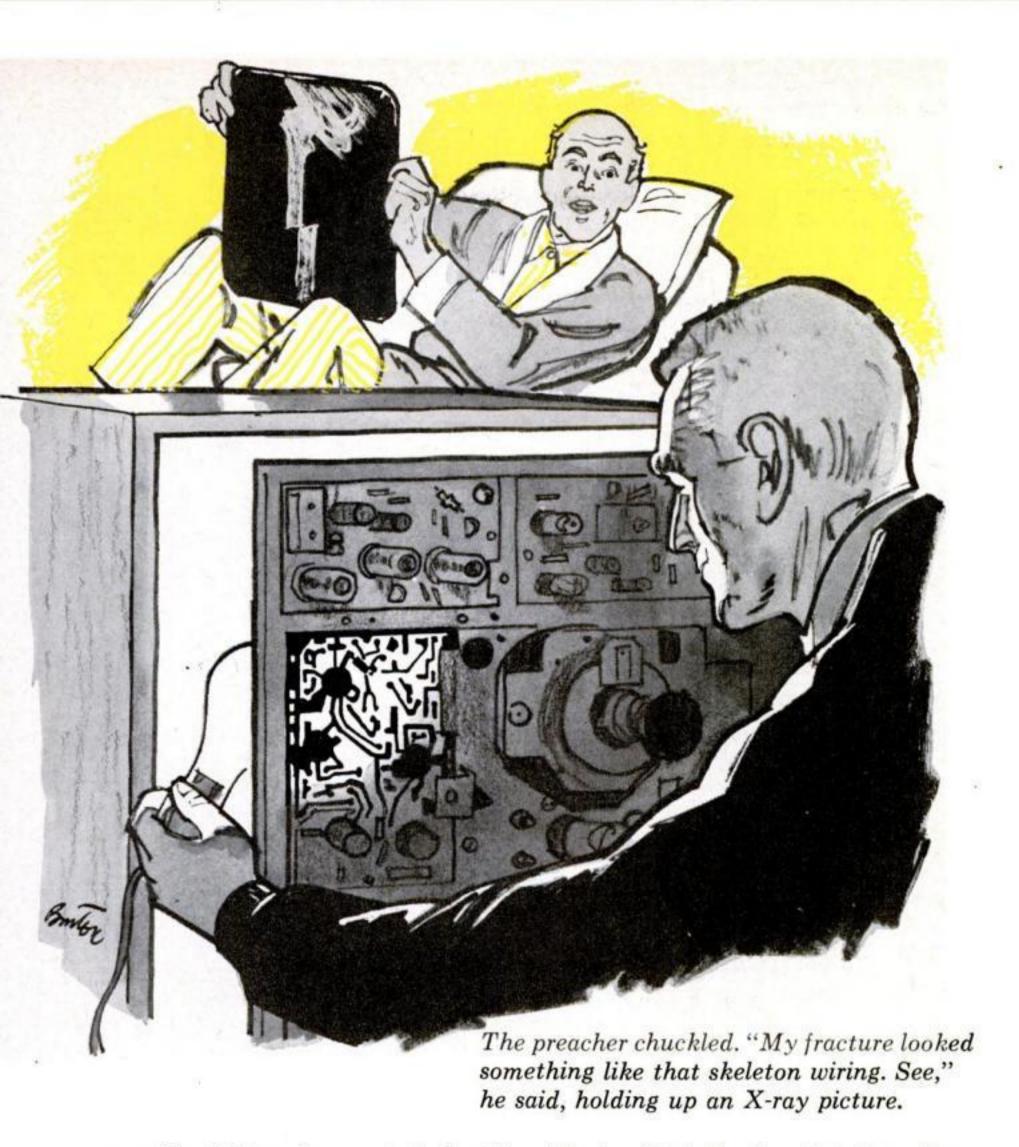
The Case for "Sloppy" Work

PETE, my kid cousin, is developing into quite a TV trouble shooter. But he's always in a hurry and his work looks sloppy. I had tried to din neatness into him with the insistent repetition of a broken record.

One day I decided to teach him a lesson in reverse. He had a 21-inch set on the bench. It had a vertical chassis, full of printed-circuit boards. I knew what was wrong with the set, but I kept that to myself.

"Pete," I said, "electronics is an art. For instance, you should try to make

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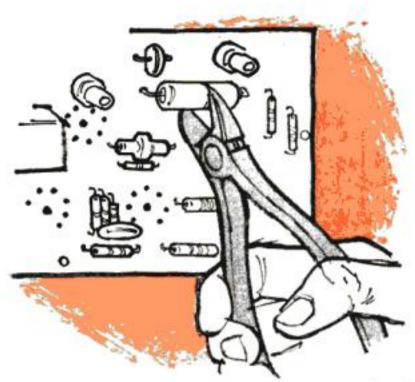
every solder joint a pleasure to look at."

"Yeah, I know," he said, switching on
the set. The screen lit up but there was
no sound or picture. As I watched, Pete
attached a needle probe to a voltmeter.
Puncturing the circuit-board varnish with
the needle, he began to take some voltage
readings.

As his probe touched the cathode of the audio-output tube, he took a closer look. It read only plus 10; the schematic called for plus 130. Then he pulled the tube and took another reading. It was still plus 10, indicating that the voltage loss had nothing to do with the tube current flow.

Pete turned the set off. "Might be one of two things," he said. "Could be a resistor between the B-plus voltage source and the cathode has increased in value. That would cause excessive voltage drop, robbing the cathode."

He paused. I nodded, and said, "Or?" "Or," he went on, "there is a short in the cathode circuit, shunting off the voltage elsewhere. Let me check."



I CHOPPED THE CONDENSER IN HALF with the dikes. Then I cleaned off the ends until I had two leads standing out from the board.

Pete read the resistors. They were right. Then he took a resistance reading, cathode to ground. Instead of 10,000 ohms, the meter showed 500. He examined the schematic. There was one .047 MF condenser between the cathode and ground.

"That's the culprit," he said, grabbing a pair of dikes (diagonal cutters). As he started to work, I coughed.

Looking up at me, he sighed, put down the dikes and picked up a long-nose pliers and soldering iron. My "sloppy-work" admonitions hadn't all been wasted. I saw he was about to detach the condenser and try to reproduce the beautiful factory wiring."

"Hold it!" I said. "That's the wrong way."

Pete dropped his tools, his face flushed. "Okay, Art," he said. "You do it your way."

I grinned, because I knew he would blow his top when he saw "my way." As I picked up the dikes and chopped the condenser in half, his jaw dropped. Then I cleaned off the condenser ends till I had two leads standing out from the board, and attached a replacement .047 to the old condenser leads. A bead of solder on each connection point finished the job. I stepped back and waited for the blowup.

It came. "You and your 'be-neat-Pete' preaching. Why, that's about the slop-piest-looking job I've ever seen."

"Granted, my boy. But every rule is made to be broken. On printed-circuits it's neat to be sloppy. You've just seen the correct way to install condensers and resistors in them. You should do as little as possible to a printed-circuit board."

"That was a dirty trick, Art," Pete said. "I was going to do it exactly that way until you stopped me. And I admit it would have been an even sloppier job."

"I know, Pete," I said. "I guess you're a natural for these printed-circuit repairs."

He still doesn't know whether to take that as a compliment or an insult.

A Fix That Hit the Jackpot

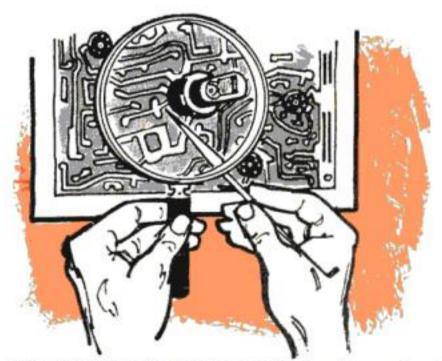
WHEN Aloysius O'Shea, our police chief, started his campaign against slot machines, I didn't see how it could affect a law-abiding TV serviceman. Then his teen-age daughter called me up.

"Please fix my TV," she pleaded, "before Daddy finds out it's a slot machine."

I puzzled over that one as I drove over. Kate met me at the door, pony tail swaying, and led me to a new portable TV with sound and picture coming in fine. I asked her what the trouble was.

She glared at me as if she knew I wouldn't believe her. "The sound goes off in the middle of my rock-and-roll program, darn it. Then I drop a quarter in this slot and it works again."

I examined a slot at the top rear of the



I HELD UP MY MAGNIFYING GLASS and examined the solder joints leading to the tube's screen . . . and there was the trouble.

set—a ventilation hole. Sure enough, there was a coin lodged about an inch down. Then the audio suddenly quit.

Kate put in another quarter. There was

[Continued on page 194]



FROM PS READERS



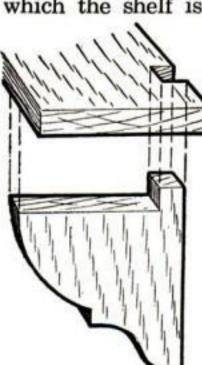
Replacing a Board in a Floor

It's easy to replace a board in a hardwood floor with a nail-cutting blade in your electric handsaw. A cut through the two edges will remove the tongues so you can lift the damaged board out. Adjust the blade for a cut just deep enough to go through the finished floor.

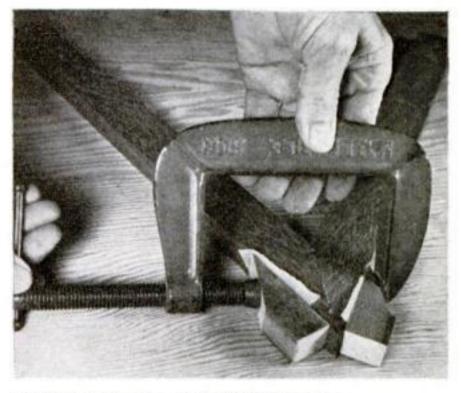
In replacing the board, trim the tongue from the new board. Carefully clean out the gap above the subflooring, measure the replacement to fit, and put in place with mastic or countersunk and puttied finishing nails. Sand, shellac and finish to match.—E. D. Craig, Dallas, Tex.

Jigsawed Shelf Brackets

You can make brackets for a shelf from the leftover ends of the same lumber from which the shelf is cut. Jigsaw them to



the shape shown, cutting a tenon on the upper ends. Then notch open mortises in the shelf so its back will fit flush against the wall. Screw the brackets to the wall through the tenon and the narrow part of the bottom section, then screw the shelf in place.—Daniel Bousha, Jackson, Mich.



Miter Faces for C Clamp

If you cut blocks of the same angle as the miter joint you are gluing up, you will give your C clamp something to bite on. Put strips of plastic foam between the blocks and the sides of the joint to keep the clamp from slipping. Scraps of foam can be obtained from a dealer or upholsterer.—Paul Corey, Sonoma, Cal.

►►► When you paint exterior wood above masonry, get a nonchalking paint from your dealer. Unlike regular house paint, it won't wash down and stain the masonry.—Juel L. Melstad, Hetland, S. D.

Answer to the Coarse-Threaded Vernier Problem

[on page 163]

Joe simply threaded half the control shaft for 3/8"-16 threads from one end and the other half for 3/8"-24 threads from the opposite end. Though turning the shaft moved both anvils in the same direction, the one mounted on the 16-thread nut would outrun the other by the difference in the thread pitches, or 1/48", on each single turn of the shaft. Each of 20 divisions on the rim of the control knob would indicate a movement of 1/960" between the two anvils.

Traffic Test for Seagoing Drivers

Here are the eight most common traffic situations afloat. How would you handle them?

OTORBOATS 16 feet long or over must carry a horn or whistle to use in situations like those shown below. Smaller boats are not required to signal.

Afloat, a horn is not blown just to attract attention. When it's blown and how many times are important to avoid confusion that could lead to a collision.

These are the sound signals you should know to operate a boat safely:

One short blast—I will pass you by keeping to my right.

Two short blasts—I will pass you by keeping to my left.

Four or more short, rapid blasts-I



1 IN A NARROW CHANNEL, you see a boat headed your way. Which side of the channel do you keep to while passing the other boat?

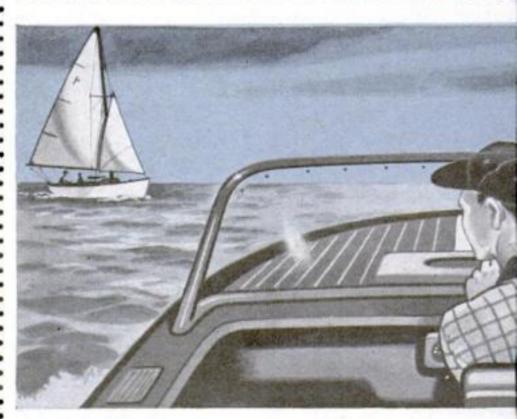


2 DEAD AHEAD is a boat coming from the opposite direction. Unless one or both of you changes course, there will be a collision.



5 CROSSING FROM THE RIGHT is a cruiser on a collision course with your boat. What action, if any, should you take?

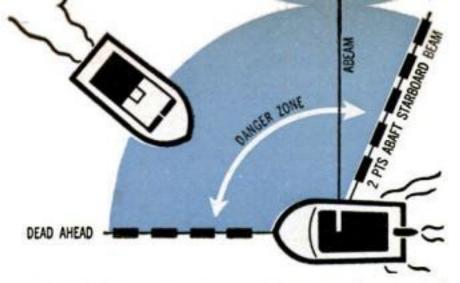




6 A SMALL SAILBOAT is headed across your bow from the left side. You are moving slightly faster in your runabout.

do not understand your signal, or what you propose to do is dangerous—don't do it. This is called the Danger Signal.

The one and two short-blast signals are used when boats meet, approach or overtake. When meeting or approaching, either boat signals and the other answers with the same number of blasts to show understanding. But if the first boat's maneuver appears dangerous, the second blows the Danger Signal. Both slow down or stop until agreed. An overtaking boat blows once or twice to indicate the side it wishes to pass on. If safe, the overtaken boat repeats the blasts; if not, it blows the Danger Signal.



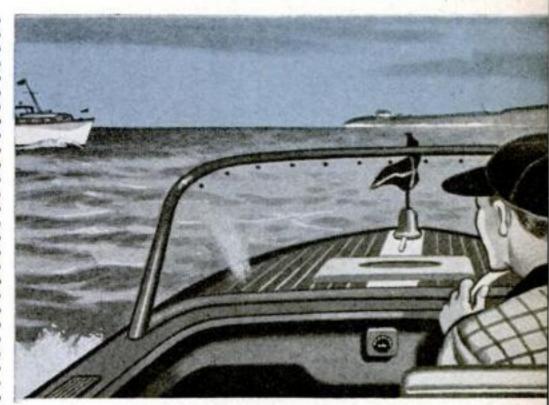
THIS DIAGRAM SUMMARIZES most of nautical driving rules. A boat approaching you from any point within the danger zone has right of way.

Please turn page for answers to water-traffic situations





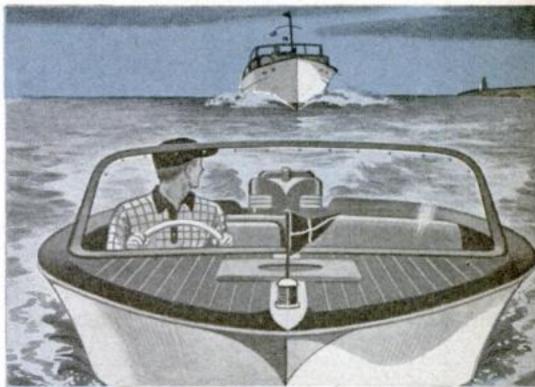
3 APPROACHING ON A REVERSE COURSE, other boat is far enough to your right to pass clear if neither boat changes direction.



4 CROSSING FROM THE LEFT is a cruiser on a collision course with your boat. One or both boats must change course or speed.



7 YOU ARE OVERTAKING a slower boat. The water is deep enough for you to pass on either side. No other boats are nearby.



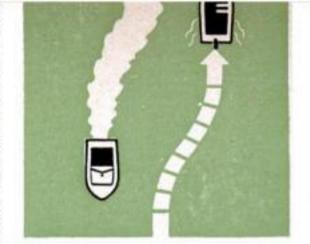
8 YOU ARE BEING OVERTAKEN by a faster boat. There is open water on both sides and no other traffic is coming toward you.

Answers to Nautical Rules of the Road Quiz on Previous Pages

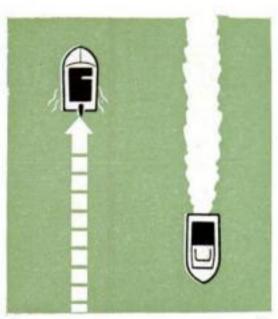
Source: Pilot Rules for Certain Inland Waters, U.S. Coast Guard publication GG-169.



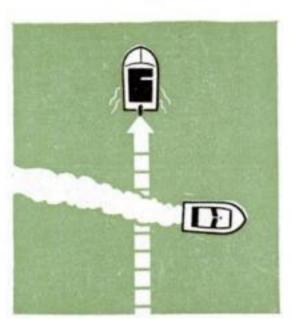
1 KEEP TO THE RIGHT in a narrow channel—as on the highway. This rule is not absolute on the water, however. If it is easier or safer to keep to left of midchannel, you may do so.



2 turn to your right, altering course enough for the other boat to pass safely on your left. He must do the same. There is no choice in this situation; you must move to the right.

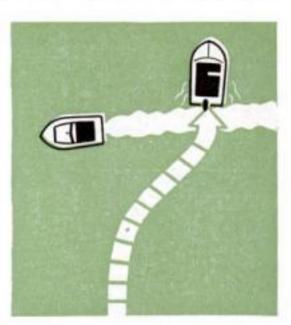


3 STAY TO YOUR LEFT until the other boat has passed safely. If your course is only slightly to the left of the other boat, turn to your right as in the dead-ahead situation.



4 HOLD COURSE AND SPEED

—you have the right of way. He should slow down or change course to pass astern of you. You must keep same course and speed to avoid confusion.

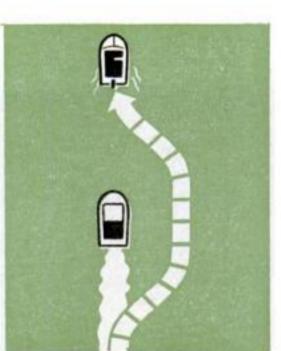


5 TURN TO YOUR RIGHT and pass astern of the other boat. Any boat approaching you from dead ahead to two points abaft the beam on your right side has right of way.



6 TURN LEFT and go astern of him. Any sailboat has the right of way over a power boat, regardless of which side it approaches, because a sailboat is more difficult to maneuver.

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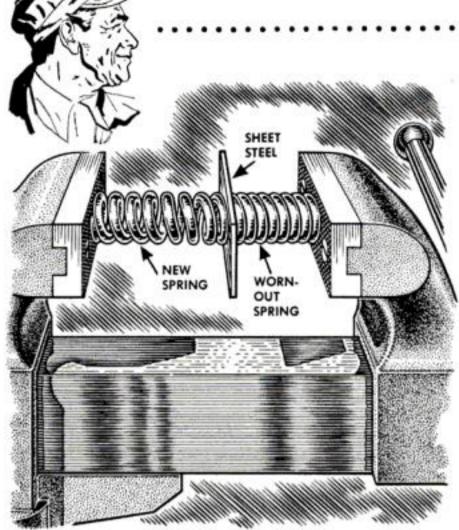


7 PULL OUT AND PASS on whichever side seems better. Give the other boat a wide berth while passing. Don't cut back on course until you are well up ahead of him, out of the way.

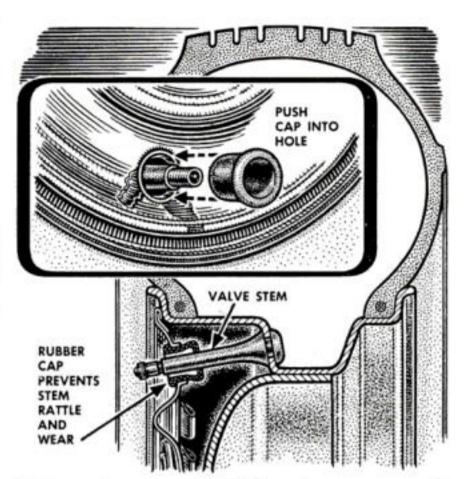


8 HOLD SAME COURSE and let the other boat pass you on either side. The Rules of the Road require you to avoid crowding on the course of an overtaking boat as it attempts to pass.

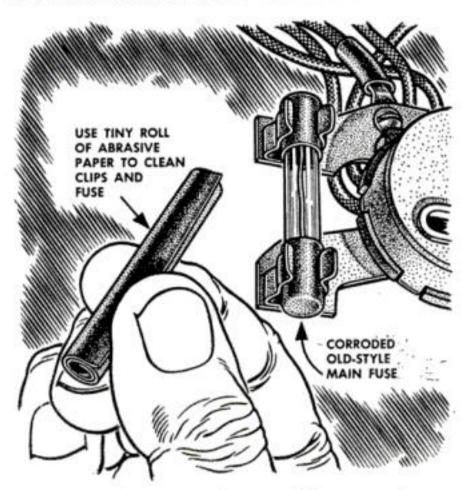
Hints from the Model Garage



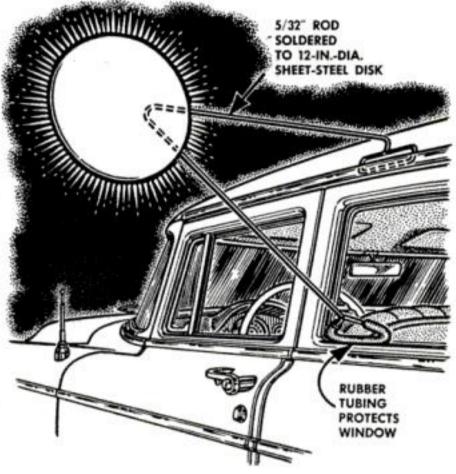
Spring check-up. To find whether a valve spring is too weak for further use, compare it with a new spring like this. Close the vise jaws just enough to support the two springs, then measure the length of each—the new one and the old one.



Valve-stem guard. Valve stems may rattle against the edges of the hole in a wheel cover. Also, the cover itself may shift, cutting the stem. To avoid both annoyances, slip a distributor-terminal nipple over the valve stem.

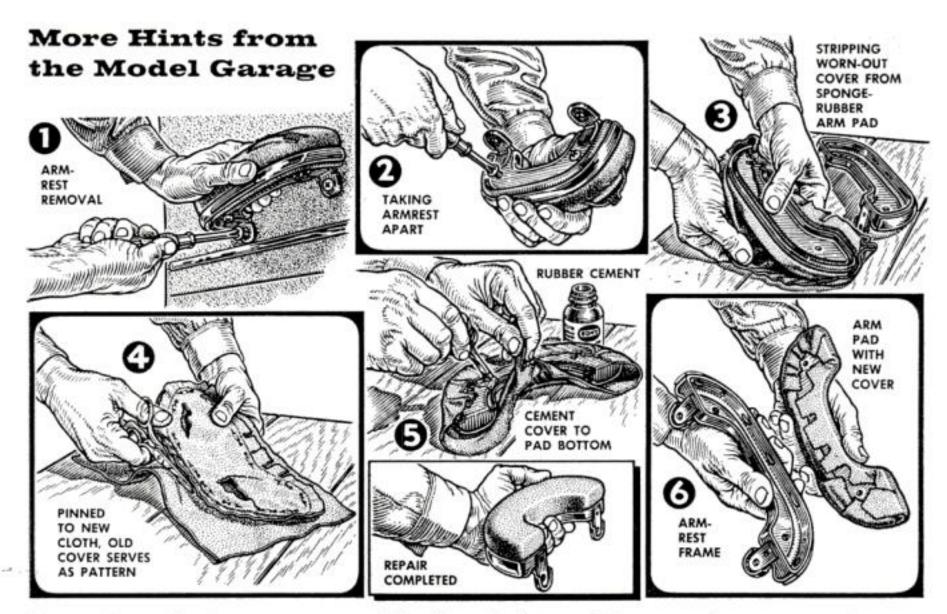


Light brightener. On an older car where the main fuse has been in place for years, corrosion may be reducing output from the head lamps. Cleaning the clip and fuse with abrasive paper will often make the lights much brighter.



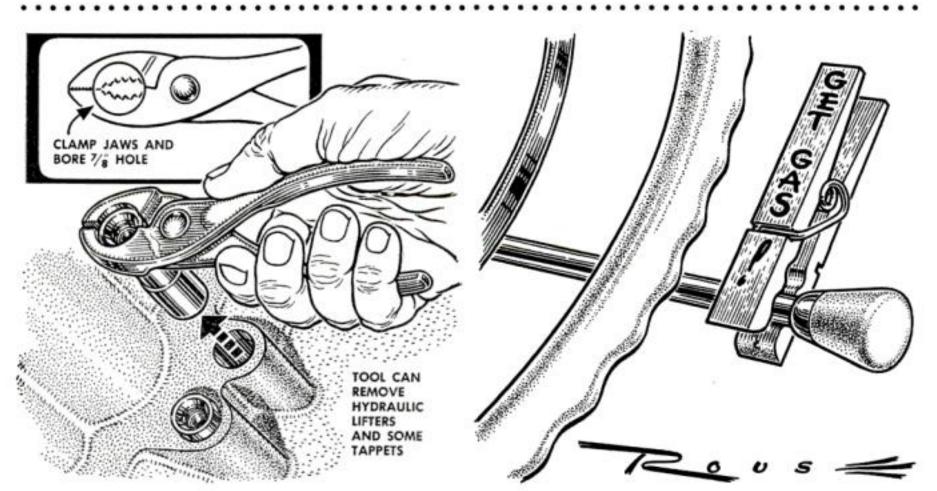
Emergency signal. For night breakdowns along the highway one motorist carries this warning signal in his trunk. The disk can be coated with reflective paint or covered with reflective tape. A pie plate could be used as the disk.

CONTINUED 171



Armrest repair. As a car grows older it's natural that the armrest on the driver's door should wear through on the top. When this happens, a new cover can be put on easily, using material that either matches or contrasts with the original up-

holstery. The normal sequence of operations is shown here. After applying cement as in Figure 5, shape the material to the pad, carefully smoothing it on the upper surface. Reassemble the armrest and the cover will remain taut.



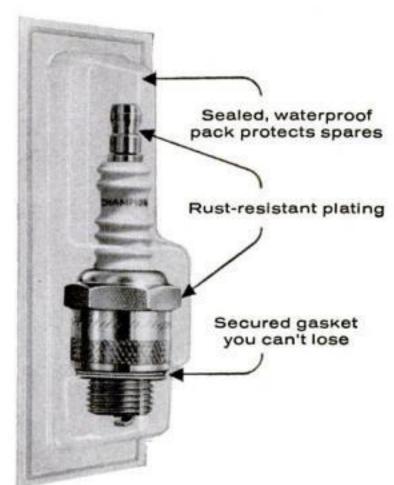
Lifter remover. One mechanic has converted an old pair of pliers into a tool for removing hydraulic lifters. The tool can also be used to remove tappets in those cars where it isn't necessary to approach them from below.

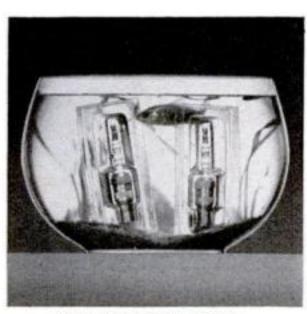
Get-gas reminder. When gas is low, remind yourself and other drivers in the family to refuel next time the car is out. Snap a market clothespin on the shift lever or steering wheel. Keep it on the sun visor when it's not in use.

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Here's why <u>your</u> choice for boating should be this <u>plated</u> Champion marine spark plug!

It's the only plug with all these features. When you carry these Champions, your spares are always in perfect condition—and easy to install even out on choppy water . . .





WATERPROOF PACK

Only plated Champions have a completely waterproof pack. After 24 hours under water, these two plated Champions went directly into an outboard ... started it on first try!





RUST-RESISTANT PLATING

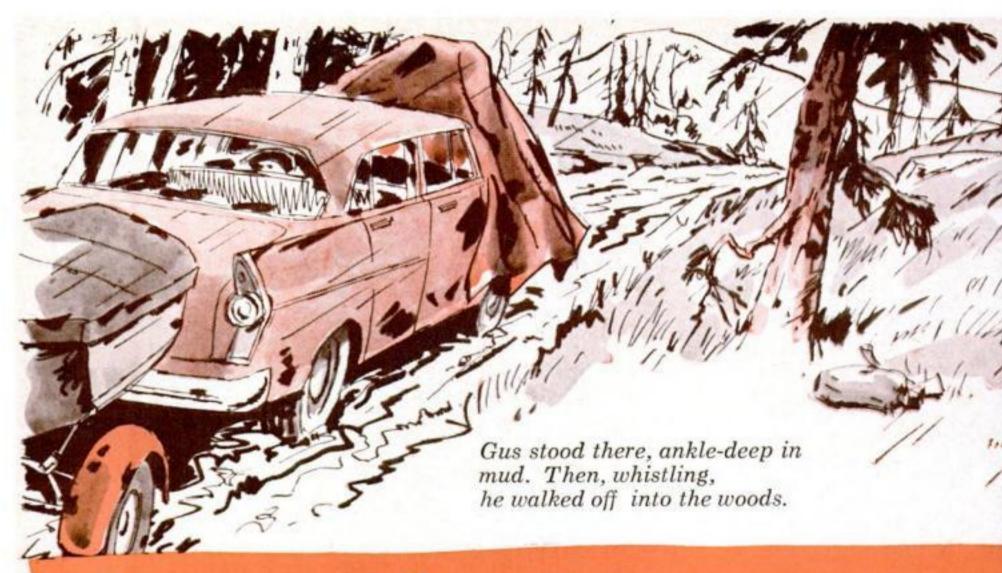
Special plating makes Champion marine spark plugs highly rust-resistant. These plugs were all soaked in fresh and salt water, then sprayed. Shiny one at right is plated Champion.



ATTACHED GASKET

This photo shows how Champion's attached gasket that can't fall off makes installation easier. You can actually install the plated Champion with one hand tied behind you!

YOU'RE A SAFER SKIPPER WITH A SPARE SET OF CHAMPION SPARK PLUGS



Gus Salvages

By Martin Bunn

US WILSON, snuggled between sleeping bags in the back seat, was dreaming of fish—big, beautiful fish that leaped to take his bait.

A clap of thunder woke him. He yawned, and stretched luxuriously. In the front seat his buddies, Pete Vancourt, who was driving, and Elmer Stoddard, were reminiscing about previous fishing trips the trio had made to Wilderness Lake.

Gus thanked his lucky stars he had an able assistant in Stan Hicks to take care of the Model Garage at vacation time. He looked back and happily eyed the boat-loaded trailer bumping behind on the mountain road.

Stoddard turned around. "Sounds as though we might run into some bad weather, Gus."

"Make the fish bite better. Relax, Elmer-think of it,

nothing to do for a week but fish and loaf."

"Then think again, Gus Wilson," Vancourt put in. "Since I'm furnishing the car, you'll do the chores. We'll have you so busy chopping wood, cooking, and washing dishes, you'll wish you were back in the Model Garage grinding valves."

"And since I'm supplying the boat," Stoddard added, "I'm counting on you to clean all the fish we catch."

"Naturally," Gus agreed, "since I'm the only one who can catch any."

"Whoa, there, Gus!" Stoddard protested. "Who caught the heavyweight last year?"

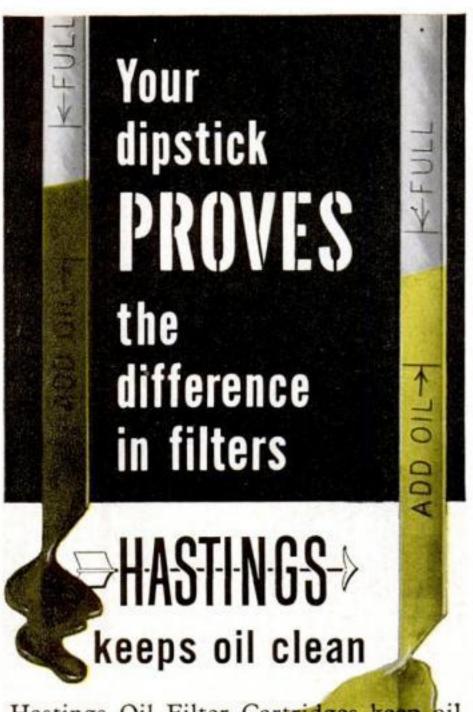
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Vacation





Hastings Oil Filter Cartridges keep oil clean from filter change to filter change, when replaced as normally recommended.*

That's because only Hastings has Densite filtering material, which traps and holds even the most microscopic dirt particles. The dipstick test proves it!

Just ask for Hastings—next filter change. Be sure of clean oil *all* the time.

*Proved by tests conducted in accordance with U.S. Bureau of Standards.

U. S. Patent Numbers 2,797,811 2,584,771



HASTINGS MANUFACTURING COMPANY
HASTINGS, MICHIGAN

Casite, Piston Rings, Oil Filters, Spark Plugs

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"Sure, after you shoved a pound of sinkers down its craw. Why, my big walleye topped your skinny pike by a good pound."

They had been climbing steadily, and as the car topped the mountain summit, a bank of black clouds, shot with lightning, moved swiftly in from the northwest. Thunder rumbled along the forested ridges as the first drops of rain fell. Then came the downpour. The winding dirt road turned to mud.

SUDDENLY the engine began to miss. Gus spoke up fast. "Keep pushing her," he warned. "We don't want a breakdown in this deluge."

"Listen to the back-seat driver," Pete

said, down-shifting to second.

"I'm listening to that engine," Gus said. The missing became worse, developed into a series of backfires. Then the car shuddered to a stop.

The three men looked at each other, silently listening to the rain beating on the car roof, the moan of wind through the swaying trees. "You," said Vancourt pointing at Gus, "are the mechanic."

"Not me. My job is cleaning fish. Re-

member?"

"Gus has a point there," Stoddard said. "Hop out and get us rolling, Pete."

Vancourt pulled out a cigarette and lit it. "If you characters are counting on me, the fish in Wilderness Lake will live to a ripe old age. I know even less about engines than Elmer here."

"Yeah, I forgot about that," Stoddard said. "It's up to you, Gus. Get out your

tools and make like a mechanic."

"What tools?" Gus asked. "When I'm invited on a vacation by so-called friends, I expect them to furnish a car, not a backfiring teakettle. I'm sleepy." He yawned, settled back among the sleeping bags and closed his eyes.

"Aw, come off it," Vancourt said, grabbing Gus's arm and shaking him. "We've still got 50 miles to go."

Gus sat up and peered out into the downpour. "I might get struck by lightning out there." He grinned. "Oh, all right, but it's just because I can't wait to get at those fish."

"That's our boy," Stoddard encouraged as Gus struggled into boots and a slicker. Pulling a floppy rain hat down

around his ears, he climbed out and dug a tool kit out of the trunk. Opening it he saw a pair of pliers, a screwdriver and a monkey wrench.

"With this I'm expected to put in new timing gears?" he asked Vancourt.

"Timing gears?"

"Sure," Gus said. "What did you think was causing all that backfiring?"

"He's kidding, Pete," Stoddard said.
"Okay," Gus admitted. "But you guys
better get busy putting a canvas tarp
over the hood or we'll drown out the
engine for sure."

WORKING together, Vancourt and Stoddard draped a canvas over the raised hood. As each held up a corner, Gus ducked underneath and went to work.

Then he started looking for some trouble that could have been caused by water thrown up over the engine by the front wheels. The backfiring in the muffler indicated that raw gas was being shunted there, and that the cylinders were firing out of time.

"Hand me a flashlight, Elmer." Stoddard dropped his tarp corner and dug

into the glove compartment.

With a better light, Gus noticed that the secondary wires to the spark plugs were held together by a fiber fixture attached to the block. The fixture was wet. Suspecting a spark leak, he removed the wires and wiped them dry with a bandanna. Next he checked ignition connections, removed the sparkplug wires from the distributor cap, and dried out the contacts by twisting the corners of his bandanna inside.

"Try her now, Pete," he shouted.

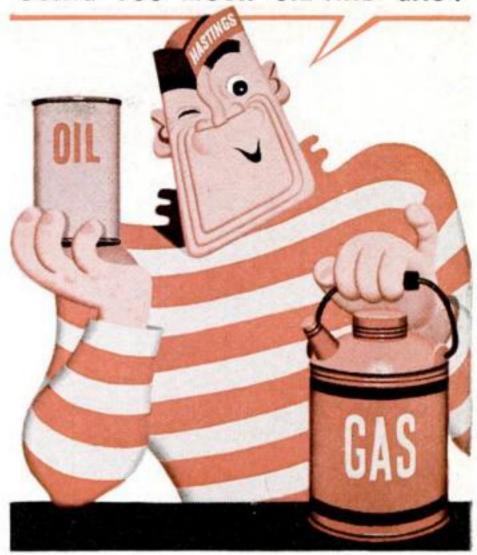
When the engine caught, it backfired like a machine gun and ran so rough it threatened to shake loose from the hangers. Gus was puzzled. He hadn't really expected to find anything seriously wrong. Now he wasn't so sure.

"Okay, that's enough, Pete," he yelled, ducking back under the canvas. It had to be ignition trouble, but locating it under these conditions was something

else.

He pulled the distributor cap, bridged the starter relay terminals with the handles of the pliers, and rocked the ignition points open on a cam lobe. The points seemed to have about the right

USING TOO MUCH OIL AND GAS?



IT'S TIME FOR HASTINGS

When your oil and gas bills start growing bigger—look out! Using too much oil is your first sign of worn-out piston rings. And worn-out rings mean power drop-off—costly waste of oil and gas—and expensive repairs later on!

The sooner you act, the less it will cost. When your motor specialist recommends new piston rings ask him for Hastings. They're engineered exclusively for replacement service . . . to provide the additional lubrication worn engines need . . . to stop oil-pumping, save gasoline, restore lost performance.

Get new car power and performance from your present car—with Hastings. Truly your best investment for many thousands of extra miles of trouble-free driving pleasure.



PISTON RINGS

TOUGH on oil pumping GENTLE on cylinder walls

HASTINGS MANUFACTURING COMPANY HASTINGS, MICHIGAN

Piston Rings, Casite, Oil Filters, Spark Plugs

gap, with no signs of pitting or burning. He turned the distributor cap over and played his flashlight inside.

There was the trouble—a jagged crack running from the center, high-tension rotor contact segment to one of the sparkplug wire terminals at the distributorcap edge. High-tension spark impulses were being diverted along this shorting crack. Meanwhile spark impulses intended for other cylinders were so weakened that missing occurred.



"I can't remember when I've enjoyed a Sunday drive so much."

TUS came out from under the canvas J shelter. "We're in a jam, boys," he announced. "Let's get in out of the rain."

When the dripping trio was seated in the car, he explained the situation.

"Now isn't that just dandy," Vancourt said. "Elmer and I bring along a bull-necked, impossible-to-get-along-with mechanic on our vacation simply because he is supposed to be able to fix things. Then, the first thing goes wrong, he gives with explanations."

"Leaving us," Stoddard added, "stuck in the mud 50 miles from nowhere. Well, we might as well break out the tent and get settled here for the night."

"Suits me," Gus agreed.

"Elmer and I'll take care of the tent," Vancourt said. "You scrounge around for some wood, Gus. Maybe we can have a fire if the rain lets up a little."

Gus stood ankle-deep in mud, gazing off into the forest. "Aren't those spruces growing on a little rise over there?"

"What's the difference?" Stoddard asked. "We're not going to chop down any trees. A few loads of fallen deadwood is all we want."

Gus was whistling as he walked into the woods. In a few minutes he was back, and stuck his head and shoulders under the open-hood shelter. His companions, wrestling with the tent, watched as he emerged, removed the canvas, shut the hood and got into the car. When he

stepped on the starter, the engine sprang to life, running smoothly.

"Well, what are we waiting for?" he called out. "Hop in and let's go fishing."

Stoddard and Vancourt lost no time in getting into the car.

"And let it be understood," Gus said, "that I'm driving the car for the rest of our vacation. You, Pete, have the fish-cleaning chore."

"For getting us out of that mess, we'd serve you breakfast in bed."

"Don't overdo it,"

Stoddard said. "But just how did you fix that crack in the distributor cap, Gus?"

"Nothing to it," Gus explained modestly. "I collected some gum oozing out of a big spruce, smeared it into the crack, and stuck a bit of paper on top."

"What kind of a fix is that?"

"It stopped the short," Gus said.
"But Elmer's right," Vancourt said. "We've got 50 miles to go and then 100 back home. We'll never make it."

"Maybe you can make a more permanent repair up at the lake," said Elmer.

"Nope," Gus said. "But I wouldn't be surprised if that spruce-gum job held up for a thousand miles."

"Have it your way," Stoddard said, "but for gosh sake take it easy so we don't jog that crack open again."

In reply Gus stepped on the gas. "Relax, you two. We'll make it all right."

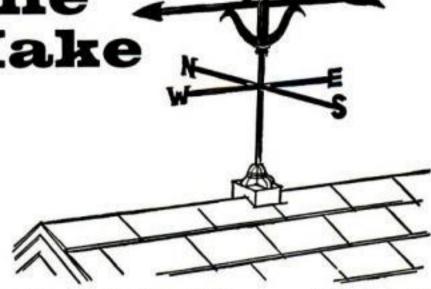
They did.

Next Month: Gus estimates a wreck.

Weldless Weather Vane Is Easy to Make

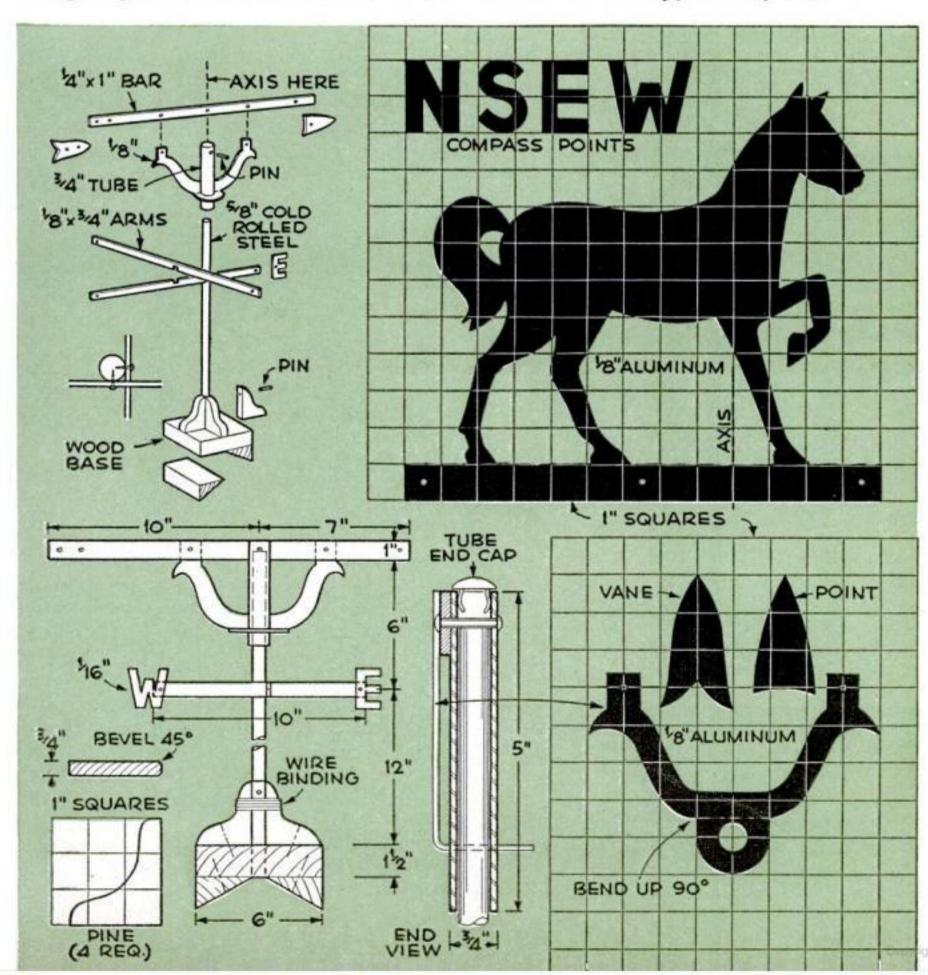
THE appearance of an expensive wrought-iron weather vane can be obtained without welding by using easily worked aluminum and painting it black.

This popular horse silhouette was cut from ½" aluminum, using a coping saw fitted with a metal-cutting blade. It is supported by an aluminum bar having a sheet-aluminum arrow tail and point riveted to its ends. The main support and pivot base also was cut from sheet metal. The silhouette swings on a tube loosely fitted over a well-greased steel pole, the top of the pole bearing against a pin that joins the arrow to the tube. Compass-point letters are riveted to the

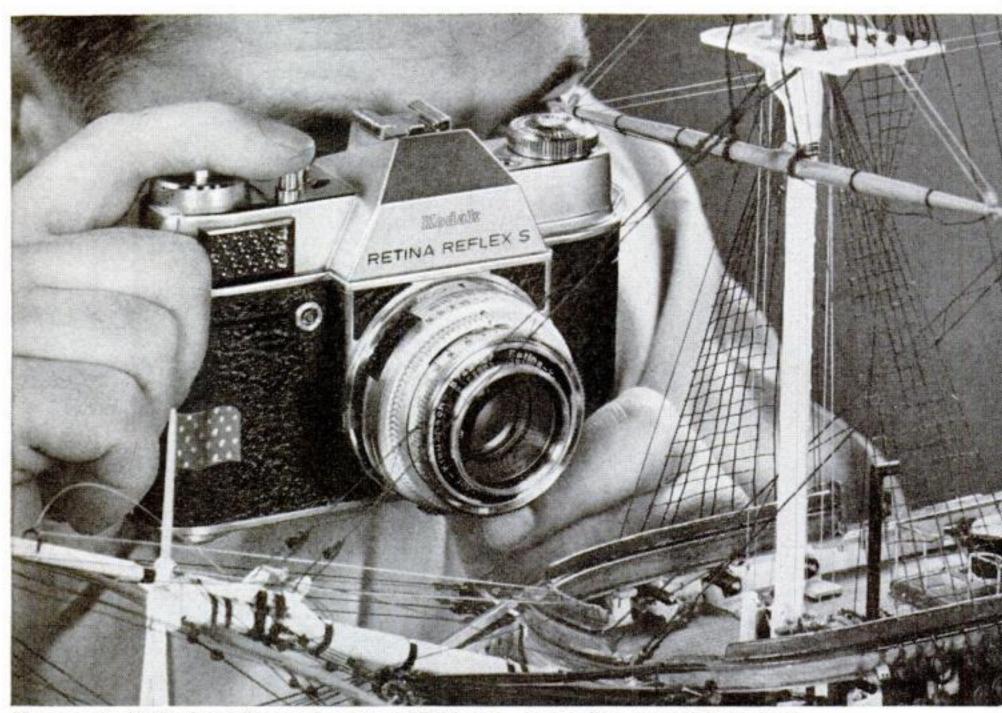


ends of $\frac{1}{4}$ " by 1" bars, notched, half-lapped and bolted to the pole.

A wood base straddles the roof peak. A tight binding of soft copper wire clamps the four base sections firmly around the steel pole. Twist the wire ends tightly with pliers and cut them off close to the wood.—Hi Sibley, Nuevo, Cal.



NEW Kodak Retina Reflex S



You can shoot this close with supplementary "R" lenses-no parallax error with any lens!



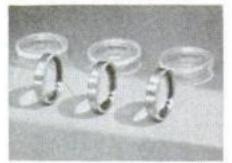
You focus needle-sharp on fine-grained full-area ground glass—or by splitimage rangefinder.



You freeze action with 1/500, fully automatic shutter. Speeds from 1 sec., B; flash synch.



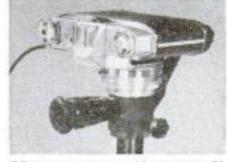
Line up a meter pointer—and your lens is set for correct exposure! For films 5 to 1300 ASA.



You command small subjects with close-up lenses —enjoy a full range of precision filters.



You wind film with a flick of the thumb...set the self-timer to get in the picture yourself.



You capture ultra-small subjects with this microscope attachment—one of many Retina photo aids.



You switch easily to wideangle or telephoto lens. Smooth, quick bayonet couplings.



You shoot from low level, get novel angles, with right-angle finder—another Retina special aid.

EASTMAN KODAK COMPANY

Camera makes you master of every picture situation!



Master of every situation? Yes. This new precision 35mm pentaprism reflex is the camera with the answers to all a hobbyist's picture needs.

Name your interests—astronomy to zoology . . . sports action to spelunking . . . car-racing to gem-cutting . . . power-boating or model-making or what you will. Pose any challenge to the Retina Reflex S and its system of aids. Then watch it respond like the thoroughbred it is!

For twenty-five years, the words "I own a Kodak Retina" have been proud words in any tongue. Every man deserves to own one supremely fine camera in his lifetime—and this new Reflex S is the finest Retina of them all.

Correct exposure? Match a pointer to the meter needle—and your lens is set at the right opening.

Precise focus? You focus and frame a big-as-life image on full-area ground glass-needle-sharp, right side up, with no framing error ever.

Field depth? Automatic pointers move as you focus—tell you the exact depth of field at all times.

Dim light? Automatic diaphragm lets you focus at wide-open brilliance with any lens.

Scene control? A superb family of wide-angle and telephoto lenses—for broad views in cramped areas, or to pull in distant scenes.

Speed? Fast-action shutter, rapid thumb-flick film advance . . . and a choice of razor-sharp 50mm f/2.8 and f/1.9 basic lenses.

Specialized aids? A complete system
 to keep pace as your interests grow.

Let your dealer tell you the full story of this great camera. The Kodak Retina Reflex S with 50 mm f/2.8 lens is \$199.50. With f/1.9, \$235. And worth every cent.



For cramped quarters choose this 28mm extreme wide-angle lens for your Retina S.



For medium wide-angle, this 35mm. All lenses also fit budget-priced Retina IIIS Camera (below).



For pleasing half-figure portraits, medium telephoto work, interchange to this 85mm tele lens.



To reach out and pull in distant scenes, pick the 135mm. Lenses pictured, \$74.50 to \$87.50.



Rochester 4, N.Y.

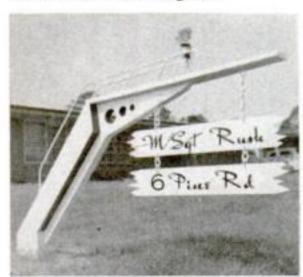
Retina IIIS Camera: Handsome, budget-priced companion to the Retina Reflex S is the new Retina IIIS—with multi-frame finder, built-in meter, automatic exposure linkage, lens interchange, rangefinder direct-coupled for all lenses. With 50 mm f/2.8 lens \$157.50. With f/1.9 \$193. Most dealers offer terms as low as 10% down. Prices are list, include Federal Tax, are subject to change without notice.

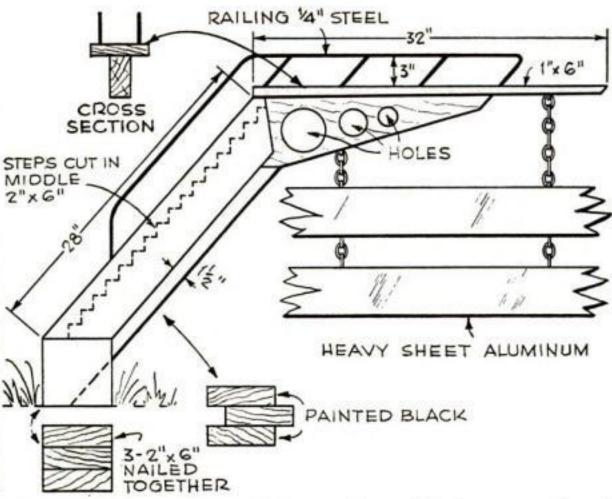
See Kodak's "The Ed Sullivan Show" and "The Adventures of Ozzie and Harriet."



Short Cuts and Tips FROM PS READERS

House Marker in Florida Style

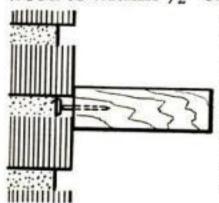




A MINIATURE diving board I put up for our name and address brings us compliments. It's built of two-by-sixes, as in the drawing. Forward edges of the stairway and inner edges of holes are painted black, everything else white. A plastic-doll bathing beauty waves to passersby. —F. C. Rush, Eglin AFB, Fla.

Nail Rake for Mortar Joint

When I built a fireplace in my den, I hit on an idea for raking mortar joints. I drove a six-penny nail into a block of wood to within \(^{1}/_{2}\)" of the head. Then, with

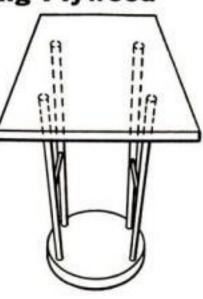


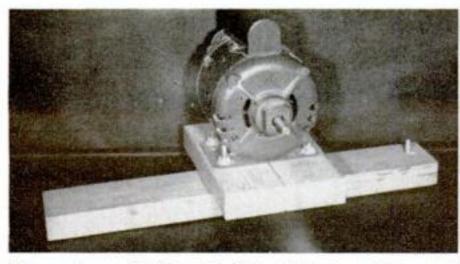
the block resting on the bricks, I raked the nail through the partly dry mortar. It made a joint that is uniformly square.— James D. Chapman, Memphis, Tenn.

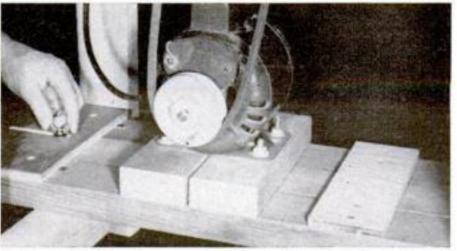
Support for Sawing Plywood

You can do much of the cutting on plywood with a portable jigsaw if you support the sheet on the feet of an inverted shop stool. With a little care, you can manipulate the saw so it won't cut the legs.

—G. E. Hendrickson, Argyle, Wis.







Tension-Adjustable Motor Mount for Small Jointer

Dressed two-by-fours joined by ½" plywood plates form this stable motor base for a small jointer. With a wing nut and bolt in the slotted plate, you can adjust motor position for any required tension on the belt. The base is built in two

parts, one sliding on the other. The motor is bolted to two blocks attached to a sliding member. Guide bars are held in place by the plywood pieces. A bolt in the slide bar projects through the slot. —C. A. Fenner, West Vancouver, Canada.

How to pass a genius



All of us can't be geniuses. But any ordinarily talented mortal can be a success—and that's more than some geniuses are.

Now, as in Æsop's time, the race doesn't always go to the one who potentially is the swiftest. The trained man has no trouble in passing the genius who hasn't improved his talents.

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□ Carpenter Foreman □ Heating □ Interior Decoration □ Painting Contractor □ Plumbing □ Reading Arch. Blueprints ■ ART □ Commercial Art □ Magazine & Book Illus. □ Show Card and □ Sign Lettering □ Sketching and Painting ■ AUTOMOTIVE □ Automobiles □ Auto Body Rebuilding and Refinishing □ Managing a Small Business □ Professional Secretary □ Public Accounting □ Purchasing Agent □ Salesmanship □ Salesmanship and Management □ Traffic Management □ CHEMICAL □ Analytical Chemistry □ Chem. Lab. Technician □ Elements of Nuclear Energy □ General Chemistry □ Matural Gas Prod. and Trans. □ Petroleum Prod. and Engr.	☐ Aircraft Drafting ☐ Architectural Drafting ☐ Drafting Machine Design ☐ Electrical Drafting ☐ Mechanical Drafting ☐ Sheet Metal Drafting ☐ Structural Drafting	☐ Diesel Engines ☐ Gas-Elec. Welding ☐ Industrial Engineering ☐ Industrial Instrumentation ☐ Industrial Metallurgy ☐ Industrial Safety ☐ Machine Design	STEAM and DIESEL POWER Combustion Engineering Power Plant Engineer Stationary Diesel Engr. Stationary Fireman	
	ELECTRICAL Electrical Engineering Elec. Engr. Technician Elec. Light and Power Practical Electrician Practical Lineman Professional Engineer (Elec)	☐ Machine Shop Practice ☐ Mechanical Engineering ☐ Professional Engineer (Mech) ☐ Quality Control ☐ Reading Shop Blueprints ☐ Refrigeration and Air Conditioning ☐ Tool Design ☐ Tool Making	TEXTILE Carding and Spinning Cotton Manufacture Cotton Warping and Weaving Loom Fixing Technician Textile Designing Textile Finishing & Dyeing Throwing	
Auto Engine Tuneup Auto Technician	☐ Professional Engineer (Chem) ☐ Pulp and Paper Making	HIGH SCHOOL ☐ High School Diploma	RADIO, TELEVISION ☐ General Electronics Tech.	☐ Warping and Weaving ☐ Worsted Manufacturing
Name		AgeHome Addre	955	
City	Zone Stat	e	Working Hours	A.M. to P.M
Occupation			send coupon to International Corres Special tuition rates to mem	

Short Cuts and Tips

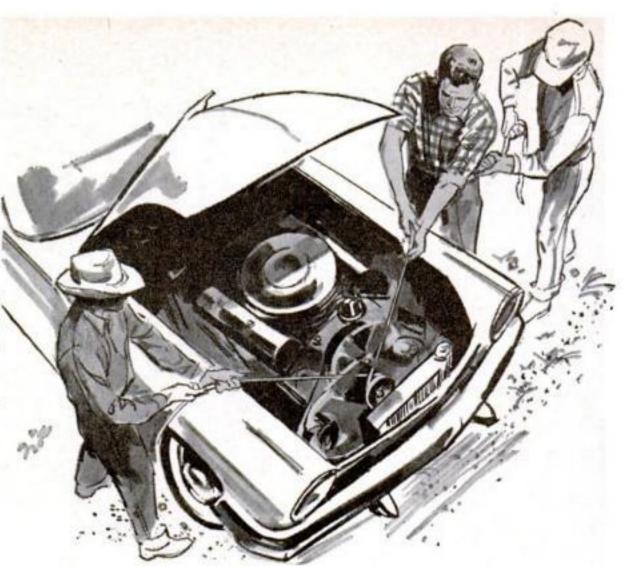
Starting Car Without a Battery

My BATTERY died and the coil was weakened by inadvertently leaving the ignition on for two days while fishing. I hit on this idea to get it started again.

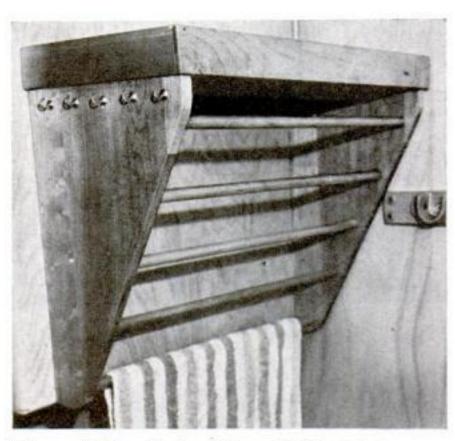
First, I removed the fan belt and loosened the adjustable slot on the generator, then circled the crankshaft pulley with a length of rope.

Next, with one man feeding the rope in while keep-

ing a steady strain, two of us gave a quick pull like starting an outboard motor. After a few pulls, the idea paid off.



Then we replaced the fan belt, being very careful because we had to leave the motor idling.—Bill McCarthy, Bathurst, Canada.

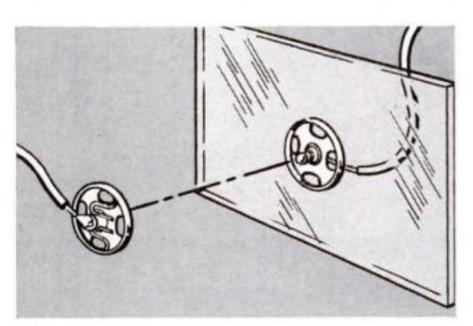


Towel Rack for Small Space

Hanging room to dry towels for five people in a small trailer or summer cottage can present a problem. If you have wall space still not in use, you can install a rack built on an incline with dowels spaced so the towels will dry.

For added convenience, put in cup hooks for wash cloths, and add a raised edge to the top to provide a shelf for toilet articles. Size and slope will be determined by the space you have available.

—Walter J. Luxenburg, San Diego, Cal.



Tiny Radio Plugs and Jacks

Instead of using bulky commercial plugs and jacks on my homemade transistor pocket radio, I made my own from snap fasteners used on clothing.

I soldered a fine wire to the back center of the male half and drilled a ½" hole for the wire in the plastic case. It could be burned in with a wire wrapped around the tip of a soldering iron. Then I inserted the wire from the outside, pulled it in tight, and mounted the snap by pushing on it with the hot soldering iron, taking care not to let it get hot enough to unsolder the wire.

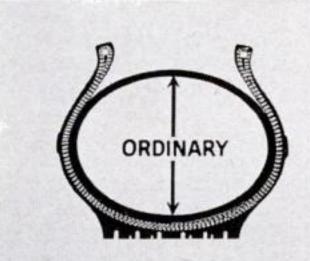
When I soldered a wire to the remaining snap, I had a good lead to headphones or an antenna.—Bob Culter, Oswego, Ore.

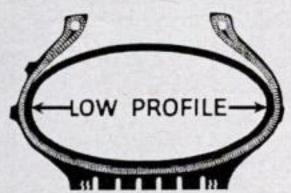
A Radically New Way To Build Tires!

LOW PROFILE



TIRES





New U. S. Royal Low Profile tires represent a radically new type of tire engineering... specifically designed to meet and exceed today's driving conditions. They are lower, wider. This unique safety-shape gives them a "cool-flexing" action. Keeps them 13° F. cooler than conventional tires. Gives them greater protection against blowouts, far greater tread mileage. Protect your family with this great new safety "first" from U. S. Royal. See your U. S. Royal Dealer.

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Originally introduced in the U.S. Royal Master, world's finest premium tire...

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See things you never saw before. Visit U.S. Rubber's new Exhibit Hall, Rockefeller Center, N.Y.

The Awesome Miracle of Lightning

[Continued from page 60]

gas in a neon tube. The "leader" hangs hesitating a moment, thickening and brightening as the electrons in the cloud swarm into it. Then it reaches down again, perhaps as much as 300 feet. Lightning may make as many as 40 steps like that, coming down. That's what gives it the familiar zigzag shape.

The activity of the positive charge on the earth may have increased now to where "streamers"—the opposite of the leaders—can be noticed leaping up from the high points in the vicinity. Photographs have been made showing them snaking as high as 50 feet upward. The phenomenon is familiarly called St. Elmo's fire. Now, in time, a streamer meets a leader and—hallelujah!—a path between the earth and the cloud has been opened. The point to be struck has been determined.

The great sky-splitting spear of light that we see is actually hurtling up, not down. It starts at the point of first contact between negative and positive charges and rips up to the cloud along the gas path which has been formed by the descending leader. The fact that the spear of light seems to travel down is an optical illusion that occurs when speeds become too great for the eye to follow: We then see what we believe, not what happens.

There is often a great pulsing in the light, made by successive strokes along the same path. There may be as many as 40 pulses in a second, which is about how long the lightning's path stays open. The heat in the path rises so abruptly that the surrounding air breaks the sound barrier in moving away. The result is thunder.

The power of a lightning bolt is truly unearthly. Eighty thousand locomotives hooked in a row couldn't work up the wallop of a single one of them. And there's plenty more where it came from—an average of 44,000 lightning storms a day around the world, few generating less than dozens, many generating thousands of strokes.

It has been estimated that a single flash of lightning develops a million times the voltage used in ordinary housewiring. This whole vast amount is delivered in a blink—a whiplash that is frequently as much as three miles long. Air is an insulating material through which electricity cannot pass. Lightning's electricity splits open and springs through this miles' high mountain of insulation with a force of 500 million horsepower, Steinmetz calculated.

Lightning usually "strikes" one of the higher points in any area—a tree, a house, a golfer on a fairway. Current flows through the object struck by the best conducting path that object offers. If your clothing is wet, the current will go through it. You may even survive such an experience, for moisture is a good conductor of electricity. But, when lightning strikes a tree, for example, whose bark is dry, it travels inside the bark, in the sap. The sap is superheated to steam instantaneously, and expands so abruptly that the tree explodes like a bomb.

It is lightning's tendency to seek out the best path offered that makes the lightning rod work as successfully as it does. When no path is offered, lightning builds one—brutally! From the top of a chimney in a country home near Pittsfield, Mass., one bolt crashed like a bomb through the wood wall to ground level. But there was no metal, no plumbing or wiring, and the ground itself at that point resisted the passage of electricity. Whereupon the lightning zipped open a trench 155 feet long, two to three feet wide, a foot or two deep, through the sod to the house of a neighbor who had put in modern improvements. punched a hole six inches wide through the concrete foundation to leap across the cellar and finally latch onto a well pipe! In a dry, rocky pasture in Utah, lightning, landing on soil that similarly resisted its passage, hunted so widely for a pathway that it electrocuted 504 sheep before finding it.

Far older than man are the horrors and terrors wrought by lightning, and they never change. The work of the devil, it was called, and a century ago the civilized world tolled bells or shot off cannon to frighten it away.

Now science has learned at last that there is good in this most awesome force. It is one of the great throes in the continuing miracle of creation and existence.



How to get thousands of extra miles from tires

- 1 Check tire pressure every week . . . or have your Texaco Dealer do it according to his accurate chart that indicates manufacturer's recommendations. Just one pound of consistent under-inflation can cut tire mileage by 1000 miles or more.
- 2 Make sure all tires have valve caps. They're not ornaments, but protect tire valve against dirt, grit and water. If one is missing, have your Texaco Dealer replace.
- 3 Don't let your spare rot in the trunk. Use it. Have your Texaco Dealer cross-switch all tires every 5000 miles to equalize wear.
- 4 Keep front wheels aligned and balanced. You'll get smoother, safer riding and steering in addition to increased mileage.

- 5 Accelerate, brake, and take curves gently. Otherwise you're scraping away precious rubber in *seconds* instead of over the miles.
- 6 When you drive with a heavy load, add a pound or two of extra pressure to each tire. This will reduce sidewall flexing, cut wear, let tires run cooler . . . safely.
- 7 Take advantage of the full riding comfort of properly inflated tires. Every 1000 miles have your car chassis lubricated with superior Marfak at your Texaco Dealer. This will give you a smoother, quieter, cushiony ride. At the same time, Marfak protects deli-

cate chassis bearings against wear and corrosion. Seals out grit, road dirt and water.



SPECIAL OFFER





How to Drive and Stay Alive [Continued from page 55]

Look out for bumps on curves ahead

In a race, a sports car entering a curve at 120 m.p.h. can be thrown clear across the track (30 feet or more) by even a small hump. Likewise your car, at 40 to 60 m.p.h., can be thrown head on against another car on a humpy turn.

I noticed that Fitch always hauled his speed down sharply if a turn ahead looked uneven. "I brake, and then tackle the turn," he said. "When you hit a hump at a curve, your wheels lose traction and there is nothing to keep your car from sliding a few feet along a tangent. This can mean a head-on crash."

Beware of driving an overloaded car

"I get chills," Fitch said, "when I see young drivers pile friends into a car with worn shocks and weak springs. Anything can happen to an overloaded car even a brand-new one.

"Many drivers don't know it, but a car with only two passengers in the rear seat takes up more 'effective width'. That's because the rear end swings out first to one side and then the other. Sideswipes are more likely to happen.

"With three or more in the back seat, most cars change dangerously from understeering to oversteering. They won't corner as well. And they won't stop nearly as fast."

On the Lime Rock sports-car course, of which Fitch is technical director, he made a series of emergency stops in my car, sliding the wheels. He rode alone. To spare the tires, the stops were made from only 35 m.p.h. Then he put five teenagers into the car. Stopping distances then increased by eight to 15 feet. At a stop sign this could put a family-filled car in the path of a truck doing 60.

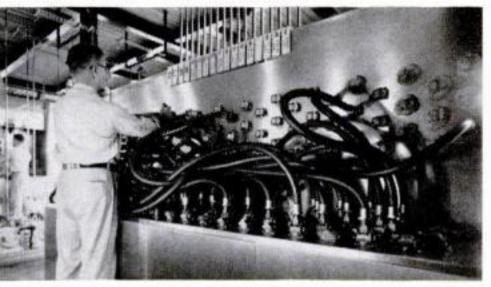
Take a low-hazard road when you can

"On a trip today," Fitch said, "you are exposed to a certain number of dangers.

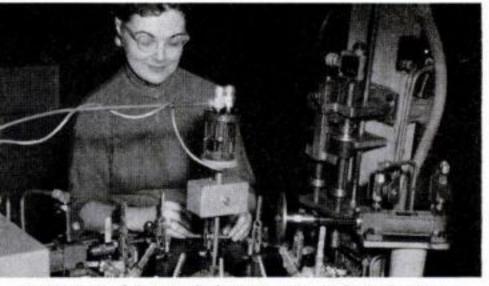
HOW AMERICA'S NUMBER ONE CARBURETOR TESTS TROUBLE OUT, BUILDS RELIABILITY IN!



The GM Desert Proving Grounds simulate the most severe summer conditions. At the same time, other parts of the country are chosen to reproduce winter and extreme altitude conditions.



Rochester-GM Carburetors keep pace with the latest advances in fuel to give you years' ahead performance and economy on today's cars and on models of the future,



Quality is carefully controlled at every stage of manufacture to assure trouble-free performance of every Rochester-GM Carburetor

Rochester-GM Carburetors must perform in all 50 states, twelve months of the year, regardless of weather conditions. To do this, trouble is tested out through millions of rugged test miles, simulating conditions in every part of the country. And, through research and careful quality controls, the makers of Rochester-GM Carburetors build reliability in! The results: the same dependable performance in June as in January. To keep this carburetor in top operating condition, it's important to see your factory-trained Rochester-GM Carburetor specialist for periodic maintenance. See him today, and see the difference. Rochester Products Division of General Motors, Rochester, New York.



Rochester-GM Carburetor specialists are taught the expert techniques of maintaining your Rochester-GM Carburetor in training schools throughout the country.

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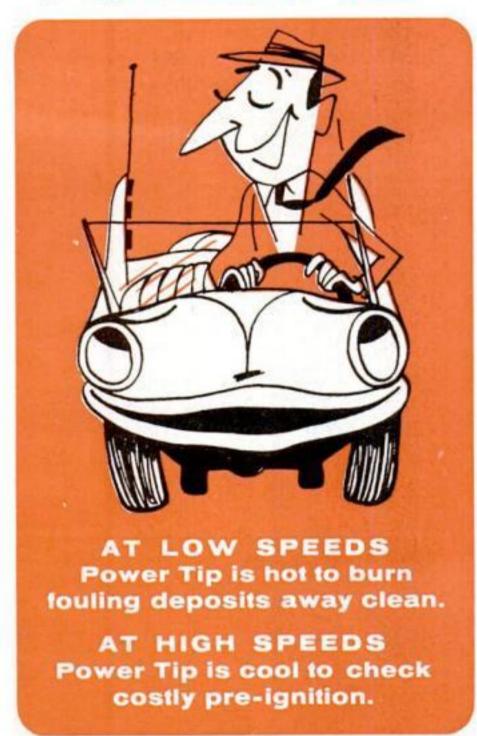


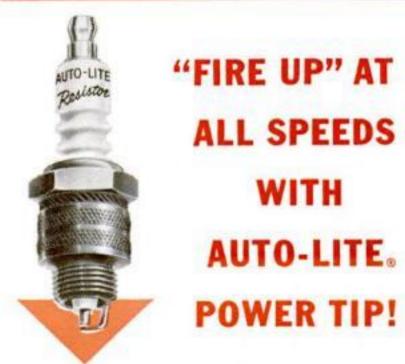
America's number one original equipment carburetors

BURETORS

GENERAL MOTORS

AUTO-LITE® RESISTOR SPARK PLUGS WITH POWER TIP





Power Tip cleans itself while you drive!

How to Drive and Stay Alive

It's like crossing a battlefield under enemy fire. They're shooting at you.

"If you cross a battlefield where there's a lot of shooting you're going to get hit sooner or later. If you cross where only a few bullets are flying, you may survive.

"I pick roads the same way. I study a map. If one route looks full of twists and hills, I know they're going to be 'shooting' at my car on every turn or hilltop. I also avoid roads that serve several busy towns or heavy industrial areas, and roads that have many intersections. These are high-hazard roads.

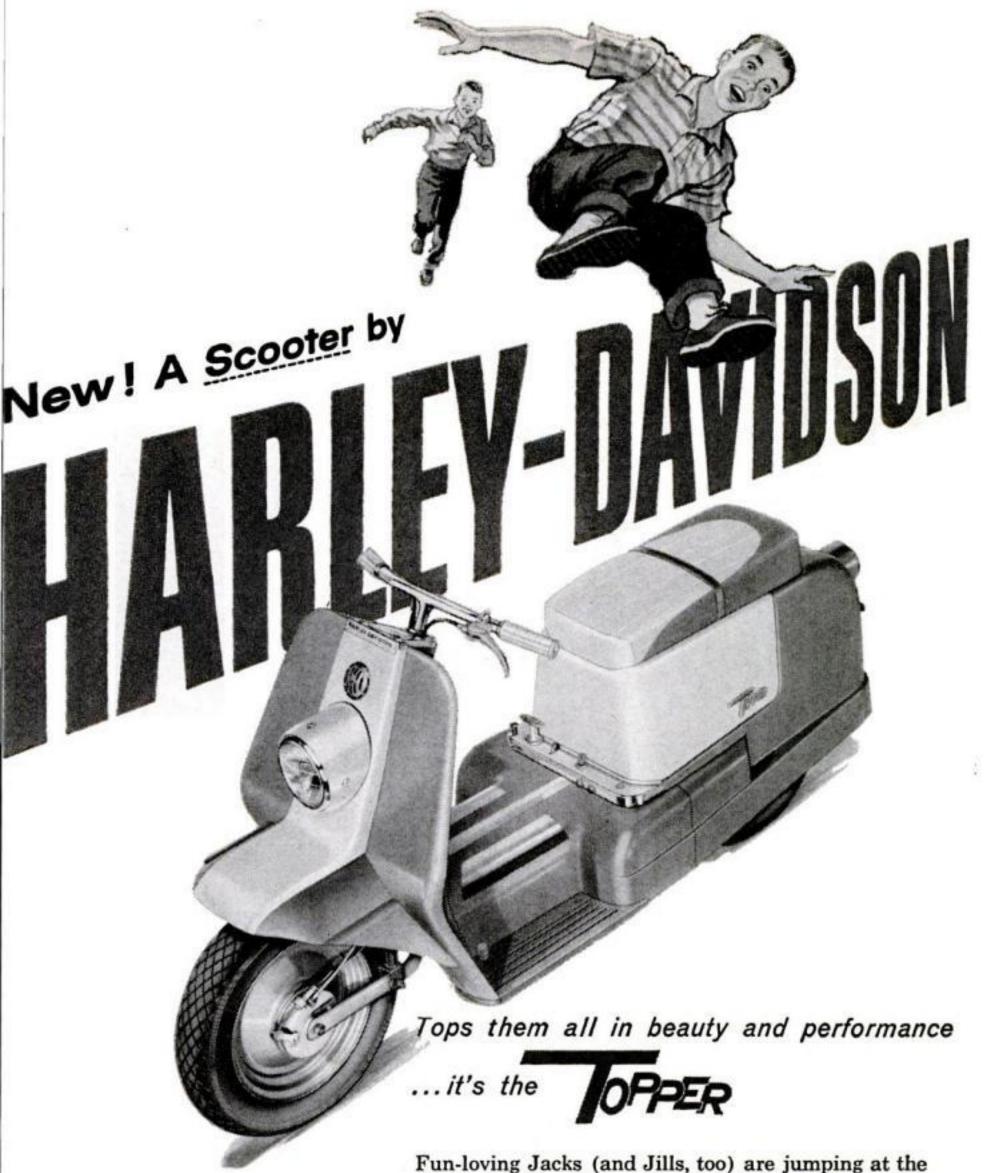
"If you want to play it smart, stick to low-hazard roads. These are straight, wide, free from intersections. If possible go by one of the modern turnpikes or expressways. Some of these are six times safer than paralleling roads. When you move over onto the turnpike, you cut your accident chances this year from one in eight to one in 48!"

Or, to put it another way, on ordinary roads, if you're "average" you're mathematically likely to have an accident within the next eight years. But if you pick high-survival roads you may go for 48 years in complete safety.

Dunked motor runs in bucket



A SPECIAL insulation system keeps windings, bearings and magnetic parts dry as the General Electric motor above operates immersed in water. It is designed for boiler pumps and underwater uses.

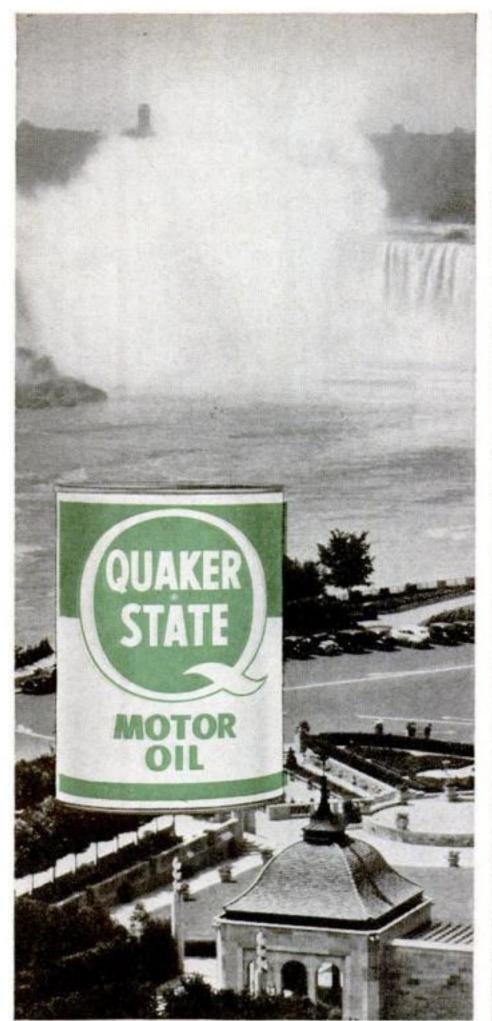


Fun-loving Jacks (and Jills, too) are jumping at the chance to meet the new Harley-Davidson Topper. And why not? There's not another motor scooter like it — combining clean, smart beauty with the newest mechanical secrets of success. Scootaway automatic transmission makes riding a snap...lowest center of gravity makes handling a dream. See the new Topper at your Harley-Davidson dealer. Or write for free, colorful folder.

HARLEY-DAVIDSON MOTOR CO.

Milwaukee 1, Wisconsin, Dept. PS

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On tour or around town, drive with Quaker State, the oil that cuts engine wear, prevents engine breakdown. Fortified with anti-wear detergent additives, this pure Pennsylvania oil stops rusting and corrosion, eliminates sludge, carbon deposits and damaging acid action. Result: moving parts work smoothly and friction-free under all driving conditions! Next oil change, insist on Quaker State.

QUAKER STATE OIL REFINING CORPORATION, OIL CITY, PA.

Member Penn. Grade Crude Oil Assn.

1859—and Founding of the Petroleum Industry—1959

First Really Portable TV Set
[Continued from page 67]

had to match the quality of ordinary nonportable "portables." It did.

POPULAR SCIENCE latched onto one of the first two built, and staff members tried it out in different places. All reports were favorable.

The picture. Quality is excellent: crisp, detailed, natural in tone. The first few sets off the line were afflicted with "center stretchout." This gives performers elongated torsos. It has been corrected, and you now get a distortion-free picture. The optical magnifying system does not seem to harm the picture at all.

Sound quality is average for TV: far from hi-fi, but satisfactory.

Sensitivity is remarkably good for such a compact receiver. We took it to the hilly suburbs 50 miles north of New York City, where reception is tricky. The Safari pulled in a picture on its own whip antenna. A table model beside it couldn't get a thing without a rooftop aerial.

We also hauled it out to Jones Beach, where the cover photo was shot. There, with bright summer sun glittering off white sand, the picture could be seen comfortably by moving right up to the small built-in visor. No other shading was required. The Safari has turned in similar performances aboard moving cars, planes and boats.

Operation is simple. You just flip the visor open and work the usual control knobs on the side. A flap on the back opens to reveal the plug for the power cord (for home use) and a knob that switches from battery to AC to battery-charging. Another flap on the bottom lets you change batteries. Beyond that, there's no easy access to the inside; Philco wants it that way.

Why it works so well. The Safari circuits are conventional, allowing for the changes imposed by transistors. There are 21 transistors of the PNP type, 12 solid diodes—and two vacuum-tube diodes (high-voltage rectifiers).

Two printed-circuit boards clearly marked—like a road map—simplify trouble-shooting. They form two sides of the chassis, with the picture tube and battery filling up most of the space in between. It makes a neat, compact and efficient assembly that pays off in convenience and performance.

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beautifully made ma- | your budget, keep scores and perform 1,001 other adding and subtracting chores . . all in a matter of seconds and ts you check bills, without a single men-tch errors, add up tal effort on your part! without a single men-

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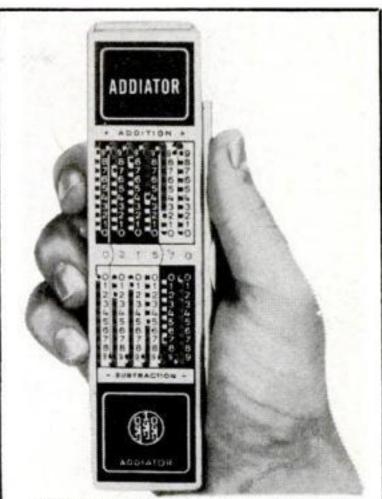
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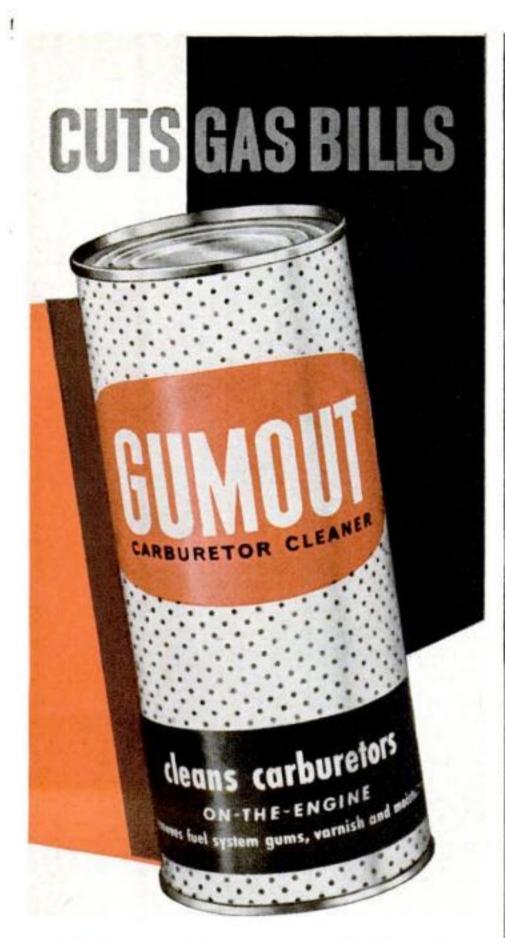
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GUMOUT • CLEVELAND 4, OHIO

[Continued from page 166]

a ringing sound and some sparks. As I turned to the screen—half expecting to see three lemons—the sound came back.

"What did I tell you?" asked Kate.

"But this is murder on my allowance."

"Where did you learn that trick?"

"One of the kids did it for a gag when the sound went. It worked. I've been paying in quarters ever since."

"Let's take a look," I said, removing the back of the set. The chassis was com-

posed of printed circuits.

I got out a magnifying glass, a needlenose pick, a can of plastic spray, a tubesocket adapter and my 35-watt soldering iron. I use a low-wattage iron. A printed circuit is a laminated-plastic board with copper foil bonded to one side. Too much heat will break the bond.

As I removed the coin from between the circuit board and the metal frame, the sound quit. Then I installed the tubesocket adapter under the audio-output tube and took voltage readings. They all checked until I touched the screen grid of the audio-output tube. There should have been plus-175-volts DC. I read zero.

Attaching the meter probe to the screen test point, I pressed the circuit board gingerly back and forth. Sputters came from the speaker. The meter needle rose to 175 and fell in beat with the sound. I held up the magnifying glass and examined the solder joints leading to the tube's screen.

And there it was—one of the most common printed-circuit troubles. A cold joint. (Factory soldering is done by machine and occasionally a joint won't take.) Wedging a quarter between board and frame pressed the joint together and current flowed—probably until speaker vibration from the rock-and-roll beat and the kids dancing knocked the coin loose.

With the hot iron, I placed a minimum of solder on the cold joint. It took. Then I sprayed on plastic and reassured Kate. "Your TV is now legal."

"You're a doll," she said. "Will the bill take what's left of my allowance?"

"Not when we've hit the jackpot," I answered, grabbing a fistful of quarters from the bottom of the portable.

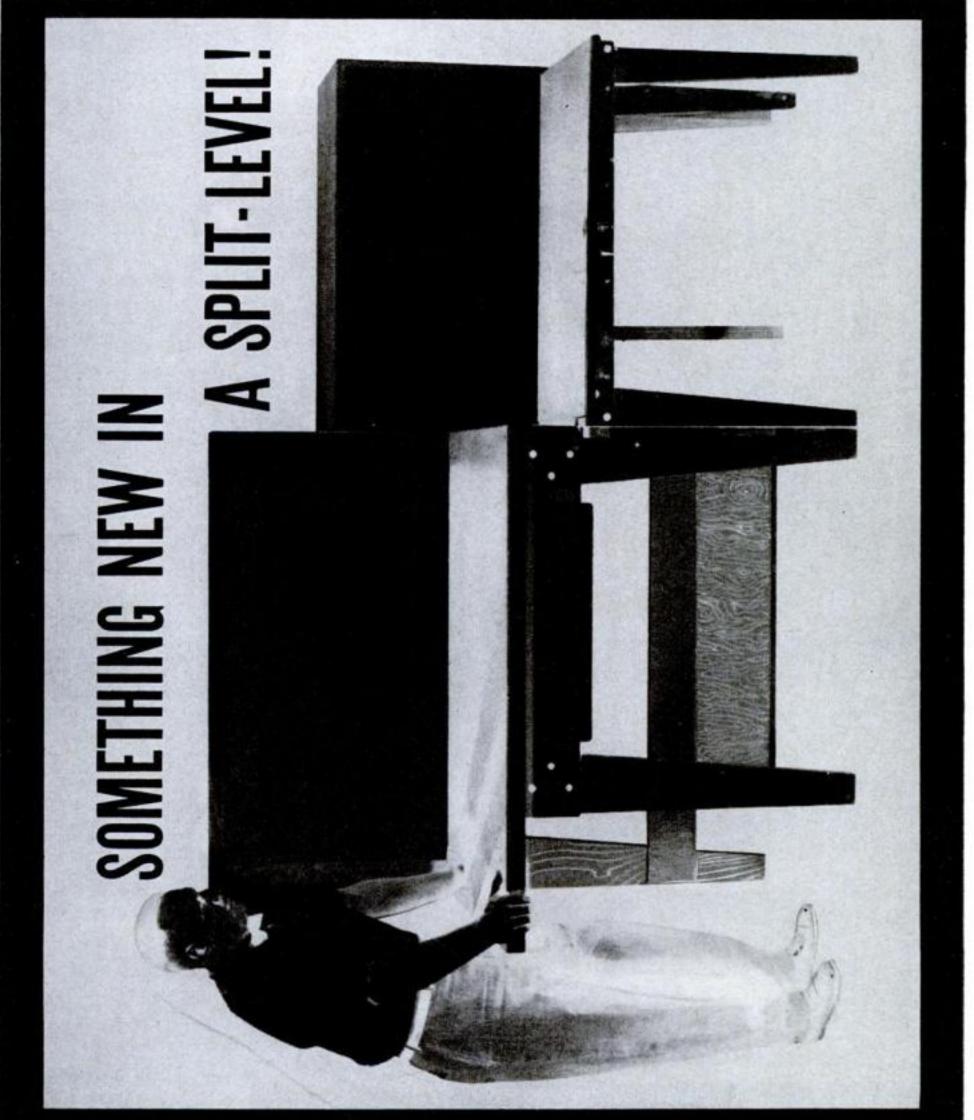
"Golly, did I put in that many?" She counted the quarters and giggled. "I can't see why Daddy is against slot machines."

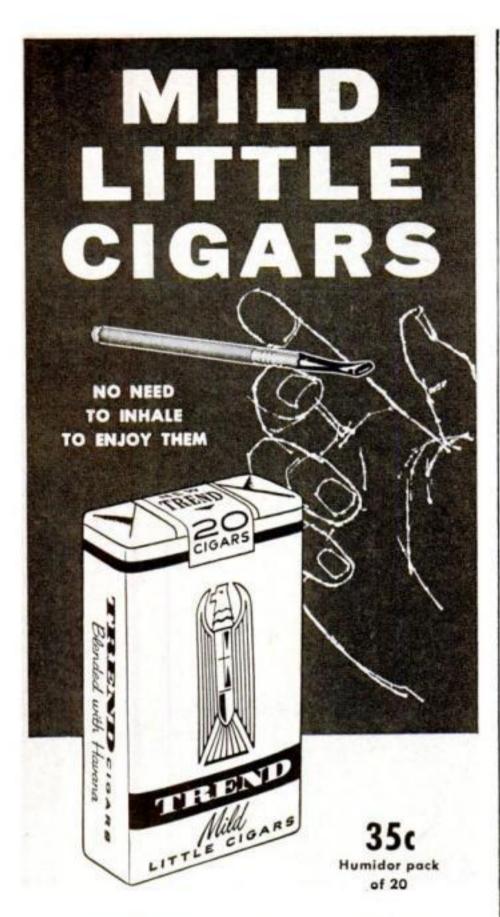
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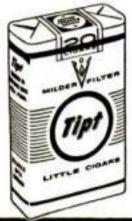




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STEPHANO BROTHERS

(Cigar Division) Phila. 7, Pa.

PIONEER IN MODERN LITTLE CIGARS

Detroit Report
[Continued from page 48]

ers—long accustomed to a high, comfortable seating position. This is regarded as a major factor in Chrysler's decision to adopt the new construction method for the coming model year.

Pit crew work at the Indianapolis 500 this year was astonishingly precise. Winner Rodger Ward's three pit stops totalled only 73 seconds—averaging less than 25 seconds each for a change of tires and full load of fuel.

Fastest stop was by Paul Russo. His Bardahl crew changed tires, added fuel and had him on his way in an amazing 19 seconds. This was outstanding, but most stops were made in less than 30 seconds, except when mechanical repairs were needed or the driver stalled his engine and had to restart it.

Built-in jacks were used on some cars for the first time this year—and very successfully. Ward's car had them; so did Jim Rathmann's (second place) and Tony Bettenhausen's (fourth place). They snap down to raise the car when a crew member hooks bottled nitrogen under pressure to a fitting, and retract automatically. Many more cars will use them next year.

There's a rumor building that Buick's Triple-Turbine Dynaflow automatic transmission may be dropped come 1960. Lack of sufficient demand and high costs are reasons cited.

Evidence is piling up that both Ford and GM are planning additional compact models. Much will depend on public reaction to the Falcon and Corvair.

Ford engineers definitely are working on a front-engine, front-drive car with a six-cylinder aluminum engine. GM is continuing efforts on a small aluminum V-8 for a front-engine, rear-drive car that would be marketed through Buick-Olds-Pontiac dealers.

Although both programs are well advanced, ultimate to-build-or-not-to-build decisions will be delayed as long as possible so acceptance of first compact jobs can be judged. Discount any reports that indicate the second batch of smaller models will show up before the normal 1961 model season—the fall of next year.



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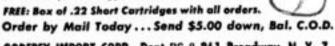
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198 POPULAR SCIENCE AUGUST 1959

Crashed Airliners Fly Again [Continued from page 118]

used bulkhead in Belem, the idle wingspar in Woonsocket, and the gear strut in Ghana?

At that, he was lucky the job wasn't in Europe. There, he'd have to consider another set of metal standards, measurements to the metric scale, even different threads on screws.

He and his team sat down and quoted a figure. After much dickering between airline and insurance company, it was agreed the airplane would be patched, flown back to New York, and returned to service as soon as possible.

Says Bill Mueller, "We threw a Band-Aid on that one. Neal had a 'barrel' shipped in—about ten feet of fuselage section from a hangar queen in Miami. We hoisted this into place with a fork-lift truck. We positioned it on a wooden cradle, then edged it up to the plane by driving wooden wedges under the cradle. Angle irons patched the rings.

"The whole arrangement was held together with aluminum patches outside of the skin."

He paused. "Sometimes, they go through a routine that always shakes me up. They think a plane is jinxed if it has cracked up. So they make a big ceremony out of changing the number. Then they invite you to get in and fly it home. In fact, they insist on it."

LASNY's pilot successfully steered his splinted bird between updrafts all the way from Barranquilla to Miami—and ran into a squall over Miami International Airport. Says one of the mechanics, "Every time we hit a bump, the whole back end of the plane flapped. Or at least it seemed that way. If I'd had some rivets, I'd have put them in by hand."

"Landing accidents keep us busiest," says Thomas. "A big part of our job is picking up planes off the runway." Take the case of the copilot who reached for the flap handle just before his Stratocruiser greased onto the runway—and pulled up the landing gear. The pilot poured on the coal to haul her off, but she was flying too slowly. The plane ground off the bottom half of her fuselage on the concrete, then settled to rest in the boondocks.

A pilot of a domestic airline plowed

CONTINUED



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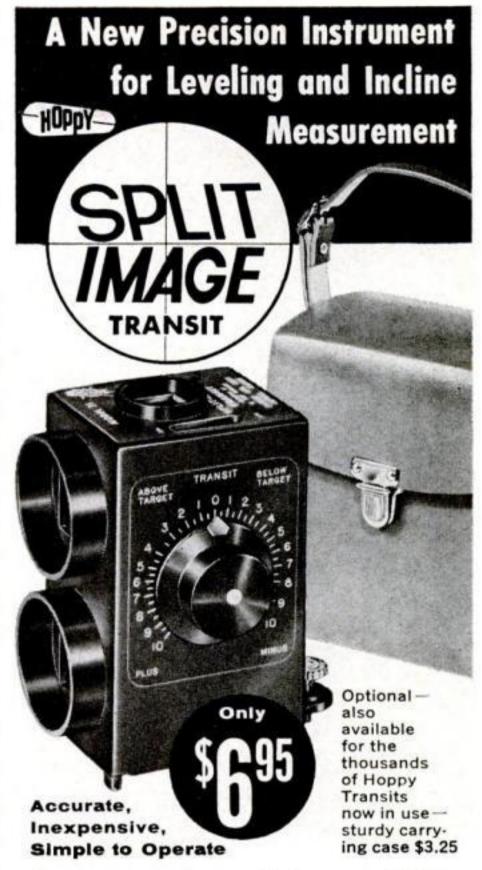
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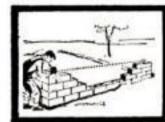
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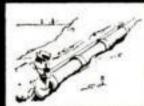
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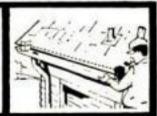
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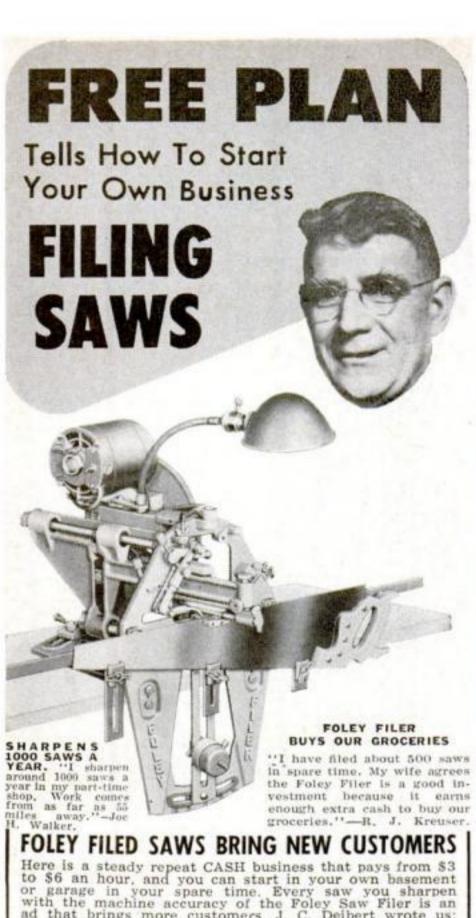
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The new model 200 Foley Saw Filer (shown above) is the first and only machine that automatically sharpens combination (rip and crosscut) circular saws—also all hand saws, band saws and crosscut circular saws. The adjustments are simple—there is no eyestrain—and you can start right away to turn out perfect cutting saws. Exclusive jointing action evens up irregular teeth—old saws cut like new!

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Crashed Airliners Fly Again

into a snow drift on a hot landing, snapped off two wheels, and skidded 1,000 feet on one wheel and a wing.

A European pilot, taxiing out to take off with 100 transatlantic passengers, heard a noise like a gunshot and felt his airliner sink to the runway. A wheel had collapsed.

These pickup jobs are often full of surprises. Thomas tells about a hurry call he got to fly to Maiquetia Airport in Caracas. The wire said that the pilot had taxied off the ramp and snapped off the right landing gear in deep mud. The left wheel was still on concrete.

When Thomas arrived, the plane was on her side in six feet of Venezuelan ooze. The outboard engine nacelle was resting on the ground. But a few questions later he said, "This one should be easy."

The crew cleared away three or four feet of mud and made a ramp of boards down to the right wheel. Thomas lashed a line to the tail and gently hauled the plane up the ramp to solid ground. As he had guessed, the gear was not broken at all. It had merely been buried, and in all the excitement, no one had bothered to get down in the ooze to look. But it's not always that easy.

How do you lift a 50-ton hulk that's flat on the ground? A hulk as big as a house? Especially if it has come to rest on the mud flats of Jamaica Bay, N. Y., the way a DC-6 did recently.

Bill Mueller tells the story. "That Six was in the middle of New York City, but it might just as well have been in the South Pacific. We couldn't get to it. The only land approach was over a spur of the City subway. We had to carry in all our gear by hand." Standard gear includes hand tools, stout line, cable clamps, lamps, a generator, power saw, and mattresses. "Mattresses," says Mueller, "protect the fuselage when we have to sling steel cables around it."

You can raise a 50-ton airplane several ways: If the spars are not cracked, you slip an I-beam under the wing and lift the beam with a pair of cranes. You can do the same thing with the special low-profile jacks developed for crash repair.

If the plane has a broken wing, you slip Goodyear lifting bags under the fuselage. A few pounds of air pressure will

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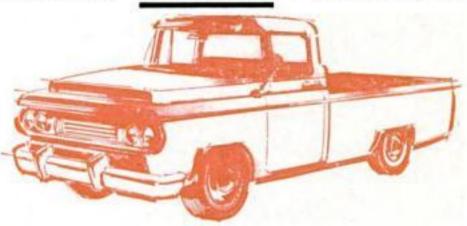
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An "overhaul" without new engine bearings is no bargain—you can tell after a few miles. Then you put up with it, or pay to do the job over. So make it *right* the first time! It costs just a few dollars more, and it's worth every cent of it.

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202 POPULAR SCIENCE AUGUST 1959

Crashed Airliners Fly Again

lift the plane several feet. Then you set it on piles of railroad ties until you can tow it away.

With salt water lapping at the floorboards of the DC-6A, etching the electrical cable and corroding the engines, the squeeze was on. Owners' orders: "Get the plane out of the water. Repair it later."

Under Bill Mueller's direction, a crew dug two trenches four feet wide and three feet deep under the wheel wells. Two barges filled with concrete were slid into the trenches. With solid support now for his jacks, Mueller inched the plane upward until he could lower the wheels. Then he built a ramp from the sunken barges to a flatboat in deep water. The boat floated the Six back to LASNY. It was one of the few times in history that a land plane taxied across Jamaica Bay. Total time: 32 hours.

Salvage is tough on Neal Thomas. If a luxury airliner lies sprawled across a busy runway at a big terminal, the airport operator puts the screws on him: "Get it out of the way or we'll bulldoze it into the mud. There's a dozen planes in the stack." Sometimes he works in rain or snow for 40 straight hours without sleep. Often he spends six months within the Arctic Circle or at the Equator.

But he gets a deep satisfaction out of raising a crippled giant from the mud and sending her aloft again. And there are always little surprises.

A domestic pilot dropped a DC-6 into the sand outside Fallon, Nev., one blustery wintry day not long ago. In the rush to leave New York, Thomas forgot to take a hat and the stores in Fallon couldn't fit him. On a long gamble, he climbed into the tilted airplane and ran his hand the length of the cabin hat rack. Nothing.

Then, through the leaning doorway to the lavatory he spied a handsome, pearlgray, ten-gallon Stetson. Forgotten in the haste of disembarking after the crash, it was obviously the in-town hat of a man of means. Probably the bold and forthright type. A Texan, no doubt.

Thomas jammed it on his head and grinned. A perfect fit. "But," he says, "I still haven't figured what the guy was doing in the 'head'—when that Six bit the dust—with his hat on."

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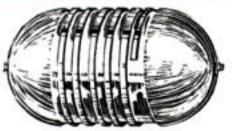
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204 POPULAR SCIENCE AUGUST 1959

How Safe Is Our A-Ship Savannah? [Continued from page 108]

slightly enriched in uranium-235. Like the Shippingport reactor, the floating one will deliver heat to make steam and run turbines. Instead of driving electric generators, however, the Savannah's turbines will turn the ship's single screw through reduction gearing. Should the A-plant fail, diesel-electric "take-home" power will be available.

Atomic strides. Since 1955 when the U. S. S. Nautilus signaled "Under way on atomic power," nuclear energy has propelled military vessels—U. S. submarines, and, more recently, a Soviet icebreaker. Now the Savannah marks the advent of A-power for merchantmen, which will free them from carrying huge tankfuls or bunkerfuls of fuel. The space thus saved can then be devoted to profitable cargo.

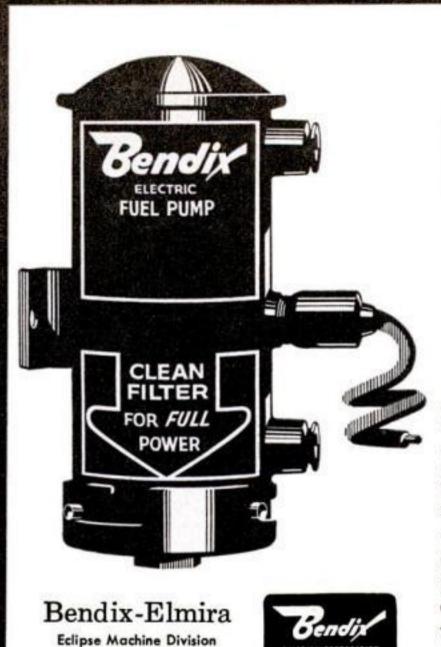
How safe? Our A-subs have churned the harbors of cities as populous as New York, Rotterdam, Oslo, Le Havre, and Cherbourg. But England has cautiously preferred to receive their visits at remote Portland (population 12,000); and Denmark, worried over a scheduled visit of the Skate to Copenhagen last year, can-

celed it entirely.

Behind such anxiety and uneasiness has been concern lest an atomic catastrophe might result if an A-sub should be in a collision or run aground; and the same questions are bound to be asked about the Savannah. How safe will she actually be?

When the Savannah's atomic reactor has been running for some time, its uranium fuel rods will contain a potent quantity of radioactive fission products. Safety demands guarding against any possibility of their escape—either into the air, as a dangerous radioactive cloud, or into the sea as noxious contamination —despite the most violent accident that could possibly befall the reactor or the Savannah.

To this end, the ship's reactor and boilers will be sealed within a massive "containment vessel" 51 feet long and 35 feet in diameter, made of steel two and a half inches thick. Accompanying illustrations show how it would prevent escape of dangerous radioactivity despite a reactor meltdown, the worst possible collision, or even the ship's sinking.



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Keeping Line Fences Within the Law [Continued from page 145]

finally decided to take his fence down. Moral: In the eyes of the law, you're only "renting" a neighbor's fence when you share its cost. You never "own" it

unless ownership is noted in the deed.

Build it in the right place. In general, a straddling or on-the-line fence looks best and wastes the least amount of land. But some owners are reluctant to incorporate agreements in their deeds for fear that they may annoy a subsequent buyer and make the property harder to sell.

If you can't get a neighbor to agree, better settle for a setback fence—one built a given distance back from your property line.

The distance of the setback depends. If your neighbor is friendly, two inches -to allow for survey error-may do if you reach an agreement for you to trespass for repair and maintenance of your fence. If he isn't friendly, better allow two full feet.

A caution: If your neighbor has a setback fence, make sure that the law doesn't forbid parallel setback fences.

Tom thought he could get around a cranky neighbor by building a similar setback fence, only to discover that the local ordinance recognized the first fence as the "established" one. He had to tear down his own fence, hook onto the existing one and pay his neighbor "rent" for the privilege, to boot.

Mind your clearances—street, alley and sidewalk. Most communities specify that a fence cannot be built on public rights-of-way. This is to protect vehicles and persons from harm from your fence.

Streets, particularly rural roads, are often deceiving. Minimum road width is usually 50 feet, yet the actual payed area is seldom more than about half this.

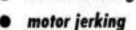
Jim, who was proud of the fine, full hedge he'd grown along the front of his yard, was happy to hear that his town had finally decided to put in a sidewalk —until he learned that his hedge would be growing smack down the middle of it.

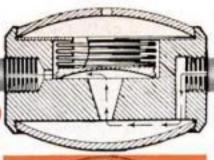
Hedges, incidentally, are fences in the eyes of many communities. The same restrictions on height and placement apply to them. Permissible fence heights vary anywhere from 3'6" to 5' for a front fence to a maximum of 6' for a side and back fence.

206 POPULAR SCIENCE AUGUST 1959

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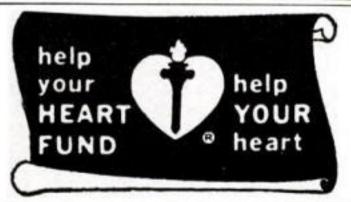
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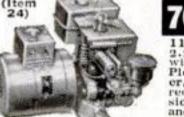
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How to Have Ants in the House

[Continued from page 153]

apart, with a circular saw, in an 8'-long piece of two-by-two pine. These kerfs take glass panels when the frame members are cut and the house assembled. Drill three small holes through the top frame member. Attach pieces of sponge under two of these for moisture, leave the other free for feeding. Fit a piece of tin or aluminum to slide along the frame and close the holes.

Two pieces of deep red cellophane fitted over the glass will cause the ants to behave as if in total darkness, but you still will be able to observe them. If desired, black paper can be held in place with pins while the ants are not being observed. (When observing for long periods it's a good idea to use a red bulb as a light source.)

Arrange the soil in the container somewhat as in an aquarium—pebbles on the bottom, coarse gravel next, fine gravel, and a thick layer of moist earth on top. When the ants are introduced, the house should be three-quarters filled with material from their natural habitat.

Complete ant colonies, consisting of workers, larvae, pupae and a queen can be bought from many of the natural history, biological or science supply houses, or through most pet shops.

More interesting, though, is for the collector to hunt his own ants. This is best done during the summer months when ant life is at its peak. The collector should take along a shovel or trowel, a large piece of cloth, forceps, some string and a pair of gloves.

Ants that build mounds are usually best for amateur study. They can be found on the southern slopes of hills, in fields, in shaded glades and under old logs and large rocks. Dig a circle a foot or so in diameter around the mound, slowly lift the cover and lay it on the ground. Capture a few workers along with a number of grubs and cocoons. Make a special effort to find and capture the queen. She is wingless, larger than the workers, and in most cases, somewhat shiny. Place earth and ants in the center of the cloth, lift up the corners and secure them with string. Replace the mound cover to help the colony reestablish itself.

When you reach home, put the sack in the refrigerator for 20 minutes to quiet

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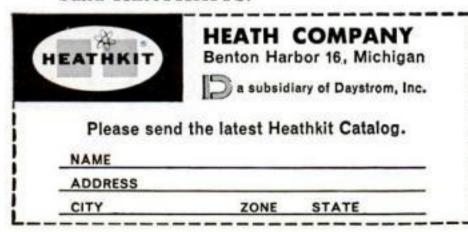
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How to Have Ants in the House

the ants and cause them to gather in clusters. Then with newspapers spread below the container—or better still, in the back yard—carefully pour ants, dirt and all into the ant house. A few drops of honey-water mixture applied with an eye dropper to one of the sponges, and the other sponge saturated with plain water, will complete the homecoming. Place the colony in a cool, dark place, and forget it for a few days while the ants build tunnels against the glass walls.

Care of the colony is simple. Keep the two sponges damp and supply a balanced menu. Most American ant species will thrive on a diet of honey water, small bits of cooked meat, dead insects and an occasional piece of nut. Different foods should be given experimentally—a little at a time and not more than can be readily disposed of-until a regular schedule is worked out.

One big treat for the ants is a twig covered with ant lice or aphids. These are the "cows", that, for their keep, secrete a sweet fluid as another item for the ants' diet.

As the ants get used to their new mode of living and settle down to routine, the careful observer will gradually make sense of what is going on. The ways of ants are certainly similar to the ways of man, but this, of course, is due to instinct rather than intelligence.

The first thing that one notices is that there are different classes of ants. By far the most common are the workers. Actually, like their cousins the worker bees, they are undeveloped females. They do all the work in the colony, except for the queen's egg-laying duties. (Sometimes the workers, too, lay eggs-but they always hatch males.)

Depending on the species and the age of the colony, there may be more than one queen. Their only duty is to lay eggs (at times up to a hundred a day), and they are pampered and preened, fed and protected by the workers.

Science-fiction enthusiasts envision planets in other galaxies with weird and exotic societies and cultures rivaling man's in complexity and organization. But consideration of the ant-who reached maturity millions of years before man was seen on earth-will give excitement and adventure to satisfy the most curious.

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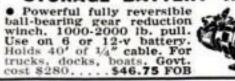
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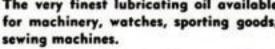
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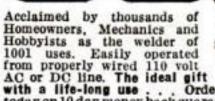
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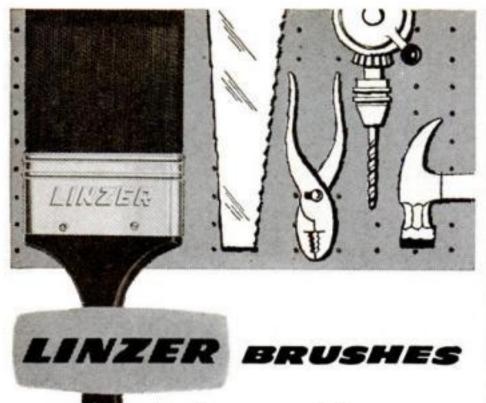
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Do You Save With a Small Car? [Continued from page 81]

as little as \$30 in the 12-month period.

Repairs come high on any car because the major cost is labor, which doesn't scale down easily even on a small car. Despite the fact that it has only four cylinders, a tune-up or valve grind is little cheaper than on a big car. It's often argued, too, that these little mills require more service because they work harder and are stressed more.

But in Endwell, N. Y., four Fiat 1100 sedans used as taxis have covered over 80,000 miles apiece. Only one has had new pistons and rings. The others haven't even been treated to a valve grind. "Oil consumption was modest up to 45,000 miles," says Earl Bouton, president of the company. "Now they burn some."

You can stretch mileage between garage bills by proper maintenance and good driving habits. A 1956 VW I know of has done 37,000 miles with nothing but a new muffler, new plugs and routine tune-ups.

What do repairs cost? A clutch overhaul on a Plymouth six runs to about \$60 in the New York area. On a Buick, parts alone come to that. One shop in Westchester County, N. Y., quoted a complete clutch job on a Dauphine at \$70, a Rambler American at \$50, and a Peugeot at \$75. Another lists labor alone on a Dauphine at \$55, and puts the total bill at \$89.

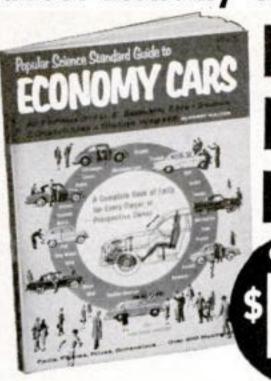
Relining brakes, I was told, would cost \$28 on a Rambler American, \$34 on a Dauphine, \$45 on a Peugeot. A New York City garage operator said the labor alone for relining Simca brakes would be \$35. Another put it at \$12.50. The moral: With imported-car servicing still young, a buyer should look hard at the service he'll get before he needs it.

At a well-equipped suburban VW agency, I was quoted \$27.50 for brake relining. The VW buyer can use a preventive maintenance schedule laid out by the factory. It's said to hold servicing costs for the first 30,000 miles to about .4 cents per mile, including grease and oil changes.

You save on tires with a smaller car, chiefly because of lighter tread loading. Heavy domestic cars commonly overload tire capacity by five percent. Most im-

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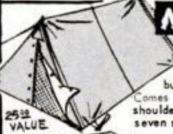
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Do You Save With a Small Car?

ports underload their tires, some by a wide margin. The result is 30,000 to 40,000 or even more miles from each.

A case history involving three cars is that of Frederick Lockwood, a publisher's representative who drives long distances. He sold a two-year-old Ford station wagon that had cost him \$3,300 for \$1,400, taking a depreciation of \$1,900 or \$950 per year. Then he bought a new Vauxhall at \$1,995.

In 13 months he put 28,000 miles on it without major repairs or tire replacement. Trading it on a Peugeot, he was allowed \$1,645, making his depreciation for the period \$350.

In seven months the Peugeot has been run 15,000 miles. Gas consumption at 60 averages 30 miles per gallon, Lock-

NEXT MONTH: It's still officially secret as you read this, but the wraps are soon coming off Detroit's first V-6 automotive engine. You'll get complete details plus a driving report in next month's issue of Popular Science.

wood says. In third-gear traffic driving, the car goes 23 to 24 miles per gallon. It burns a quart of oil every 2,000 miles. Total maintenance and service for 15,000 miles, including towing when a pump gasket blew, comes to \$78.98.

To sum up, you can probably save a substantial amount on gas, oil and tires by driving a four-cylinder economy car with a manual shift. You'll make secondary yearly savings on license, financing and depreciation costs.

If you drive under 5,000 miles a year, the per-mile savings will not be impressive. You may as well wheel a big car, and enjoy the advantages of greater capacity, flashy getaway, extra trunk space and automatic drive. Or you might compromise on a six, which has adequate oomph, lots of room, splits the difference in per-mile costs, and runs about the same as larger imports in first cost and depreciation.

But if you cover big mileage, or like to use the car without thinking about cost, an economy four may be just the ticket. The smart thing is to know what the choices are. That way, you pay only for what you really want.

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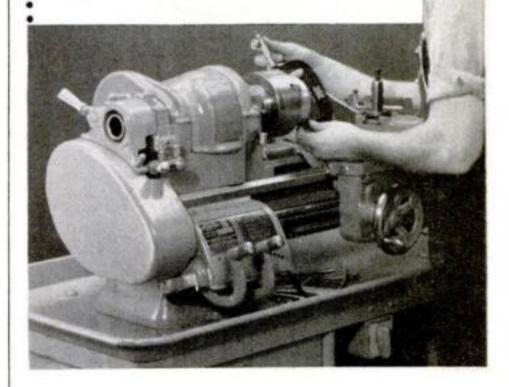
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Together, we studied the graph.

"Your breathing was very steady," he remarked, pointing to the top line, "except that right after the fourth question, as you can see, you exhaled a bit more than after any other. That might have been caused by a little sigh of relief."

His pencil moved to the second line.

"Your galvanograph is erratic," he noted, "probably because of a slight general tension about taking the test. But it hit a peak just as I was about to ask the fourth question. It was whether or not the sum you took was about \$500. You had become aware that I was raising the amount \$100 with each question, and that peak indicates a surge of tension as you anticipated the figure \$500.

"Now," he continued, pointing to the bottom line. "Your blood pressure was steady, and your heart—except that just after the fourth question, it gave a little

extra beat. See that upstroke?

"Putting all these bits of evidence together," he concluded, "I'd say there was around \$500 in that wallet."

I looked at him in wonder.

"You're certainly right," I said. "But I don't understand how I gave myself away. I wasn't conscious of any special emotion when I lied about the amount."

He laughed. "Well, now you know you can't fool a lie detector. People come here under the influence of liquor, or sedatives or dope—any one of which would make the test results unreliable. But we can spot them fast, and we refuse to test them that way."

"Aren't there other ways of distorting the polygraph record—ways that might be more subtle?"

"You want to try a few?" the lieutenant asked. I nodded, and he hooked me up to the apparatus again.

First, I stealthily squeezed my left hand into a tight fist.

"Aha!" exclaimed Lt. Puddy. "Look at the bottom line of the graph."

I glanced over at it. The stylus that was making the blood-pressure-and-pulse recording had nearly shot off the paper.

"You know enough about this already to realize that that is a completely abnormal response. Nobody's blood pressure or heart would behave like that."

Next, I crossed my legs and tensed the

muscles in them. Again the bottom stylus of the polygraph went wild, and the galvanograph recording, on the middle line, looked hysterical.

I tried one more trick. I held my breath for an instant or two, as a guilty subject might do to try to slow his pounding heart.

It was useless. Lt. Puddy showed me a telltale pattern on the top line of the graph. The stylus had moved upward as I inhaled, and then drawn a broad plateau that continued until I exhaled.

"When we catch a subject doing that," the lieutenant said, "we sometimes just stop asking questions, to see how long he can hold his breath."

"Well, I give up," I said. "The lie detector wins."

"Don't be too readily impressed," Lt. Puddy warned me. "The polygraph is a fine, sensitive scientific instrument, but it is of no value at all without a well-trained, fully experienced operator. That's why courts hesitate to accept it.

"At best," he continued, "the polygraph is a very valuable aid to investigation—but it is no substitute for it.

"Almost anybody can learn the mechanics of the equipment in half an hour, but it's how the operator asks the questions, and what questions he asks, that count. It takes months to learn these details."

Los Angeles, whose Police Department began experimenting with polygraph examinations in 1924, was the first major U. S. city to give the lie detector serious official status. The Police Department's Scientific Investigation Division now has six polygraph operators. All are college graduates, and have undergone long, intensive training before being allowed to test subjects on their own.

They have had the satisfaction of helping to nab the guilty, and the greater satisfaction of clearing the innocent.

And they have learned that one of the greatest assets of the lie detector is its psychological impact. Over and over again, a person undergoing a polygraph test becomes so awed by the accuracy with which his emotions are exposed that he doesn't even finish.

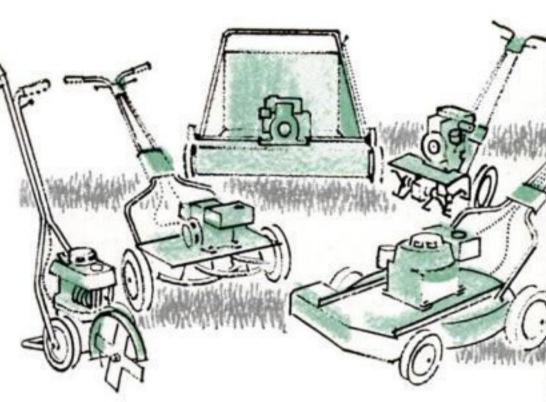
"Aw, what's the use?" he'll say hopelessly. "I might as well tell you . . ."

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Why Does Daddy Sleep So Much?

Sometimes I couldn't blame my little boy for wondering. It seemed as though the only thing my husband enjoyed was SLEEP!

Night after night my husband came home from work completely worn out - nervous and irritable. He often skipped supper and fell right into bed. What kind of companionship was this for his children, his friends, his wife?

Frankly, I was worried. My husband used to be such an active, energetic man. But for some reason he now seemed too tired to do anything. Even on weekends, when other men went places and had fun with their families—he complained of being just too tired! I wondered what I could do to help him.

One day I saw a Vitasafe ad in a magazine. It said that some men, just like my husband, could

easily lose their natural pep and energy, feel wornout and run-down, act nervous and irritable because of a prolonged deficiency of essential vitamins and minerals in their diets. The ad revealed that thousands of otherwise normally healthy people had increased their pep and vitality through the famous Vitasafe Plan. Maybe this Plan could help my husband too.

I sent for the 30-day trial supply of Vitasafe High-Potency Capsules that was offered, and when they arrived, 1 sy husband started taking just one a day. Before long he was acting like his old self again — peppy, energetic, and wide awake!

If you'd like to help your husband as I did mine, mail the coupon below for a 30-day trial supply of proven Vitasafe High-Potency Capsules without risking a pennyl



A dramatization posed by professional models.



25¢ just to help cover shipping expenses of this

FREE 30 days supply High-Potency Capsules

LIPOTROPIC FACTORS, VITAMINS and MINERALS

Safe, Nutritional Formula Containing 27 Proven Ingredients: Glutamic Acid, Choline, Inositol, Methionine. Citrus Bioflavonoid, 11 Vitamins (Including Blood-Building B12 and Folic Acid) Plus 11 Minerals

To prove to you the remarkable advantages of the Vitasafe Plan . . . we will send you a free 30-day supply of high-potency VITASAFE C.F. CAPSULES so you can discover for yourself how much stronger, happier and peppier you may feel after a few days' trial! Just one VITASAFE CAPSULE daily supplies your body with adequate amounts of each and every vitamin believed essential to human nutrition. Also included in this exclusive formula are Glutamic Acid an important protein constituent derived from natural wheat gluten-and Citrus Bioflavonoid. This formula is so complete it is available nowhere else at this price!

HOW AMAZING PLAN SLASHES VITAMIN PRICES ALMOST IN HALF

With your free 30-day supply of Vitasafe High-Potency Capsules you will also receive complete details regarding the benefits of an amazing new Plan that 8"VITASAFE" REG. T.M. © 1959 VITASAFE CORP.

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I ENCLOSE 25¢ PER PACKAGE for packing and posts	ge.
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This offer is limited to those who have never before taken of this generous trial. Only one trial supply under each family. IN CANADA: 394 Symington Ave., Toronto 9, (Canadian Formula adjusted to local conditions)	advantage h plan per Ont.

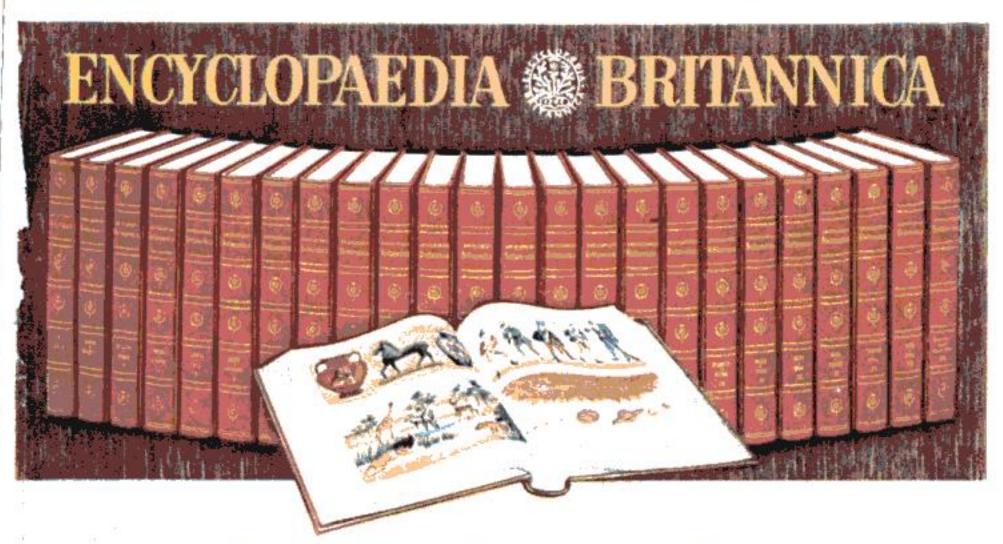
provides you regularly with all the factory-fresh vita mins and minerals you will need. By participating in the Vitasafe Plan now you are never under any obliga tion! When you have received your first 30-day tria supply, simply take one VITASAFE Capsule every day to prove that this formula can help you as it is helping so many others. But you remain the sole judge. If you are not completely satisfied, and do not wish to receive any additional vitamins, simply let us know by writ ing us before the next monthly shipment - or you can use the handy instruction card we will provide - and no future shipments will be sent. Yes, you are unde no purchase obligation ever; you may cancel future shipments at any time!

But if you are delighted - as so many people al ready are - you don't do a thing and you will continue to receive fresh, additional shipments regularly every month - for just as long as you wish, automatically and on time - at the low Plan rate of only \$2.78 plus a few cents shipping for each month supply. You take no risk whatsoever—you may drop out of this Plan any time you wish without spending an extra penny, by simply noti fying us of your decision a few days before your nex monthly shipment. Take advantage of our generous offer! Mail coupon NOW.

Choline .	Vitamin C	75 mg. 1	Phosphorous	58 mg
Bitartrate 31.4 mg.	Vitamin B.	5 mg.	iron	30 mg
Inositol 15 mg.	Vitamin B ₂	2.5 mg.	Cobalt	0.04 mg
di-Methionine 10 mg.	Vitamin Be	0.5 mg.	Copper	0.45 mg
Glutamie Acid 50 mg.	Vitamin B ₁₂	2 mcg.	Manganese	0.5 mg
Lemon Bioflavonoid	Niacin Amide	40 mg.	Molybdenum	0.1 mg
Complex 5 mg.	Calcium		lodine	
Vitamin A	Pantothenate	4 mg.	A	0.075 mg
12,500 USP Units	Vitamin E	2 I.U.	Potassium	2 mg
Vitamin D	Folic Acid	0.5 mg.	Zine	0.5 mg
1,000 USP Units	Calcium	75 mg.	Magnesium	3 mg

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